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ИНОСТРАННЫЙ ЯЗЫК

АВТОМАТИЗАЦИЯ ТЕХНОЛОГИЧЕСКИХ ПРОЦЕССОВ И ПРОИЗВОДСТВ В МЕТАЛЛУРГИЧЕСКОЙ ПРОМЫШЛЕННОСТИ

ENGLISH FOR SPECIFIC PURPOSES
METALLURGICAL PROCESS CONTROL AND AUTOMATION

*Методические указания к практическим занятиям
для студентов бакалавриата направления 15.03.04*

САНКТ-ПЕТЕРБУРГ
2023

УДК 811.111 (073)

ИНОСТРАННЫЙ ЯЗЫК. Автоматизация технологических процессов и производств в металлургической промышленности. (ENGLISH FOR SPECIFIC PURPOSES. Metallurgical process control and automation). Методические указания к практическим занятиям / Санкт-Петербургский горный университет. Сост.: *С.А. Свешникова, М.А. Троицкая.* СПб, 2023. 36 с.

Методические указания предназначены для студентов направления подготовки 15.03.04 «Автоматизация технологических процессов и производств». На материале аутентичных текстов, в которых освещаются основные аспекты истории, современного состояния и перспективы развития автоматизации технологических процессов и производств, студенты смогут овладеть необходимой лексикой для чтения и понимания профессиональной литературы на английском языке, а также развить навыки реферирования и перевода технических текстов по специальности.

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UNIT 1. WHAT IS AUTOMATION?

Before You Read

1 Discuss the following questions with your partner:

1. Why is automation relevant now?
2. Do you know much about your future profession?
3. Which area in this field is the most interesting for you?
4. Why have you chosen this career path? What are advantages and disadvantages of your future profession?
5. What qualities should a professional engineer in automation have?

2 Practice reading and pronouncing the following words:

accuracy; actuator; automatically; automation; breakthrough; cells; computerized; dimensional; evolutionary; extrusion; forging; grind; numerical; predetermined; revolutionary; sequence; simultaneous; technique.

While You Read

3 Read the passage and answer the questions below:

1. What is automation?
2. What automation tool do you know?
3. Why is the notion of automation more evolutionary than revolutionary?
4. What are the common steps of manufacturing?
5. When did the development of automation begin?
6. What were the stages of automation evolution?
7. What is the classification of manufacturing systems presented in the reading passage based on?
8. What is the difference between manufacturing cells and manufacturing systems?
9. Do you know what hard automation is?
10. What are flow lines and transfer lines used for?

Automation generally is defined as the process of enabling machines to follow a predetermined sequence of operations with little or no human intervention and using specialized equipment and devices that perform and control manufacturing processes and operations. Full

automation is achieved through various devices, sensors, actuators, techniques, and equipment that are capable of monitoring all aspects of, making decisions concerning changes that should be made in, and controlling all aspects of, the operation.

Automation is an evolutionary rather than a revolutionary concept. In manufacturing plants, for example, it has been implemented especially in the following basic areas of activity:

➢ manufacturing processes: Machining, forging, cold extrusion, casting, powder metallurgy, and grinding operations.

➢ material handling and movement: Materials and parts in various stages of completion are moved throughout a plant by computer controlled equipment, with little or no human guidance.

➢ inspection: Parts are inspected automatically for dimensional accuracy, surface finish, quality, and various specific characteristics during their manufacture (in-process inspection).

➢ assembly: Individually manufactured parts and components are assembled automatically into subassemblies and then assemblies to complete a product.

➢ packaging: Products are packaged automatically for shipment.

The major breakthrough in automation began with numerical control (NC) of machine tools in the early 1950s. Since this historic development, rapid progress has been made in automating almost all aspects of manufacturing, from the introduction of computers into automation, to computerized numerical control (CNC) and adaptive control (AC), to industrial robots, to computer-aided design, engineering, and manufacturing (CAD/CAE/CAM) and computer-integrated manufacturing (CIM) systems.

Manufacturing systems, in order of increasing automation, include the following classifications:

• job shops: These facilities use general-purpose machines and machining centres with high levels of labour involvement.

• stand-alone NC production: This method uses numerically controlled machines, but with significant operator-machine interaction.

• manufacturing cells: These cells use a cluster of machines with integrated computer control and flexible material handling, often with industrial robots.

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•   flexible manufacturing systems: These systems use computer control of all aspects of manufacturing, the simultaneous incorporation of a number of manufacturing cells, and automated material-handling systems.

•   flexible manufacturing lines: These lines organize computer-controlled machinery in production lines instead of cells. Part transfer is through hard automation and product flow is more limited than in flexible manufacturing systems, but the throughput is larger for higher production quantities.

•   flow lines and transfer lines: These lines consist of organized groupings of machinery with automated material handling between machines. The manufacturing line is designed with limited or no flexibility, since the goal is to produce a single part.

After You Read

4 When you hear or read a new word or phrase that is important to you, add it to your *Vocabulary Notebook*. Next to each item, write down a sentence containing the word that will help you remember its meaning. Look back at the reading passage and find words or expressions that are related to industrial process automation. Add them to the chart below:

Vocabulary Notebook

English	part of speech	Russian	example
automation	n	автоматизация	*Automation generally is defined as the process of enabling machines to follow a predetermined sequence of operations with little or no human intervention and using specialized equipment and devices that perform and control manufacturing processes and operations.*

English	part of speech	Russian	example

5 When you learn a new word, it's useful to learn other forms of the same word. Complete the chart below by adding the missing word forms. Then check your ideas by looking in a dictionary.

noun	verb	adjective
assembly	assemble	assembled
automation		
		determined
	perform	
	achieve	
	machine	
operation		
		implemented
extrusion		
completion		
		adaptive
interaction		

Speaking

6 Sum up the information from the text using the plan:

1. Definition of Automation
2. Basic Manufacturing Activities
3. Stages of Automation Development

4. Types of Automated Manufacturing Systems

Your summary should be about **one-third of the original text**.

Critical Thinking

7 Work with your partner and put the following activities into two categories: a) soft (flexible) and b) hard (fixed) automation:

a) conventional flow lines;
b) manufacturing cells;
c) manufacturing lines;
d) manufacturing systems;
e) stand-alone NC production;
f) transfer lines.

8 What metallurgical processes do you know? Match the following processes with their definitions:

metallurgical processes	definitions
1. annealing	a) heating a material above its recrystallization temperature, maintaining a suitable temperature for a suitable amount of time, and then allow slow cooling;
2. casting	b) manufacturing process involving the shaping of metal using localized compressive forces;
3. extrusion	c) metal forming process in which metal stock is passed through one or more pairs of rolls to reduce the thickness and to make the thickness uniform;
4. forging	d) metal-joining process in which metals are joined together by melting and putting a filler metal (solder) into the joint, the filler metal having a lower melting point than the adjoining metal; at a higher temperature;
5. machining	e) metal-joining process in which metals or thermoplastics are joined together by using high heat to melt the parts together and allowing them to cool causing fusion;
6. rolling	f) process in which a piece of raw material is cut into a desired final shape and size by using special machinery;
7. sintering	g) process of compacting and forming a solid mass of material by heat or pressure without melting it to the point of liquefaction;
8. soldering	h) process of heat treating, which is used to increase

metallurgical processes	definitions
	the toughness of iron-based alloys by heating to some temperature below the critical point for a certain period of time, then allowing them to cool in still air;
9. tempering	i) process of pouring molten metal into a mould, where it solidifies into the shape of the mould;
10. welding	j) process of pushing a material is pushed through a die of the desired cross-section to create objects of a fixed cross-sectional profile.

9 Automation can be applied to the manufacturing of all types of goods, from raw materials to finished products, and in all types of production, from job shops to large manufacturing facilities. What do you think the goals of automation in metallurgy are today?

Translation Challenge

10 Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

Traditional models describing metallurgical processes such as sintering, roasting, smelting, leaching, precipitation, electrolysis, refining, solidification, etc., range from turbulent flow to multi-phase flow models. However, at the heart of these processes, very complex multi-phase and multi-physics processes take place. Under these circumstances, empirical data is difficult to obtain and modelling is a complementary and promising path to follow. Furthermore, modelling and simulation is a useful tool employed to analyse metallurgical processes in depth, such as those of a blast furnace, which are usually characterized by high costs and energy consumption. In fact, process simulations derived from versatile mathematical, physical, or data-driven models have the potential to provide effective analysis tools to improve metallurgical processes, resulting in enhanced quality at lower costs and often contributing to better sustainability.

<div align="right">(822 characters)</div>

UNIT 2. PROCESS AUTOMATION TOOLS

Before You Read

1 Discuss the following questions with your partner:

1. What is industrial process automation?
2. Can we automate all manufacturing processes?
3. How is artificial intelligence used in automation?
4. What automation tools do you know?
5. What types of interfaces are there?

2 Practice reading and pronouncing the following words:

augmented; automate, automation; capabilities; cognitive; conundrum; intelligent; legacy; maintenance; manipulate; multiple; orchestration; precise, precision; virtual.

While You Read

3 Read the passage about a classification of the most common process automation tools. Pay attention to the words and word combinations **in bold**. When you don't know the meaning of a word, look at the words around it to help you. You may be able to guess the meaning of the word from its surrounding context.

What are the different types of process automation tools?

Process automation tools are categorized into:

1. General **process automation tools** which work with multiple **platforms** and can serve any industry or business function.

1.1 **Robotic process automation (RPA)** & **cognitive automation tools** are the most flexible tools thanks to their **screen scraping capabilities** and their ability to manipulate the **user interface (UI)** like a human. This is a big advantage in **automat**ing legacy **applications** that only have a **user interface** but not an **application programmer interface (API)**.

Robotic process automation tools are newcomers to the world of **automation**. In short **RPA bots** are the most flexible breed of **automation tools**. They have integrations with most modern systems and they have **advanced screen scraping**, **image recognition** and **OCR**

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capabilities allowing them to use a **desktop** like a human to complete tasks requiring multiple systems.

However, as they gain in flexibility, **RPA tools** lose in precision. They are not able to deal with as precise, **low level instruction**s **as IT process automation (ITPA)** tools. This also makes them easy to use, most **RPA software** has simple **drag&drop programming interface**s. Any curious office employee can harness the power of **RPA systems** to accomplish their daily tasks and lighten their workload. So depending on the needs of the project, a more focused or flexible tool should be chosen.

RPA bots are augmented with **AI capabilities** that help them learn from previous examples and use **Natural Language Processing** or **image recognition capabilities**. These **augmented bots** are sometimes called **cognitive** or **intelligent bot**s. They are provided by **RPA** companies and the line between **RPA bots** and **intelligent bots** is quite blurry.

1.2 **Low code application platforms** allow rapid **automation** of modern **application**s by non-technical users. They were initially built to rapidly **develop applications** with **graphical user interface** (GUI). They also involve **process orchestration** features to enable **end-to-end process management**.

They are flexible tools that can be used in any industry or business to rapidly **develop applications** and **automate tasks**. They are easier to use than **RPA tools** and can be preferred when **automat**ing **processes** and tasks using modern systems with **APIs**.

2. Business function specific automation tools

Business units have specific **automation** needs and these needs can be satisfied by **specialized process automation tools** which can **automate** complex multi-system dependent processes.

ITPA is the most popular **business function specific automation**, helping **IT departments automate** complex processes. Since these tools are used by experienced **IT professionals**, **UX** has been less of a concern in this space.

IT departments have for a long time struggled with the 80/20 conundrum: spending 80% of their effort on maintenance and just 20% on improving the systems so they improve business outcomes and reduces their maintenance effort. **ITPA** helps **IT departments** reduce

maintenance time by **automat**ing common tasks. For example, provisioning of a **virtual server** which normally requires numerous **manual** steps can be fully **automate**d. The **automation module** would take the steps below and finalize **server provision** without any **IT personnel** involvement.

After You Read

3 An abbreviation is a shortened form of a word or phrase used to represent the complete form. There are four main kinds of abbreviations: shortenings (e.g. in = inch, zoo = zoological garden), contractions (e.g. Dr. = doctor, St. = saint or street), initialisms (e.g. CIA / C.I.A., NYC, pm/p.m.), and acronyms (e.g. AIDS, laser, scuba, UNESCO). There are a lot of abbreviations in the reading passage, try to fill in the following table with them using, for example, https://www.acronymfinder.com.

abbreviation	complete form	по-русски
AI	artificial intelligence	искусственный разум
API		
GUI		
IT		
ITPA		
OCR		
RPA		
UI		
UX		

4 Do you know what the following abbreviations stand for?

CNC, CSIA, DCS, EC, FB, HSP, HMI, HTTP, ISA, NEC, P&ID, PC, PFD, PID, PLC, SCADA, SIL, SSI.

Can you match them with their Russian equivalents below?

Автоматизированная система управления (АСУ); Ассоциация интеграторов управляющих систем; встроенный контроллер; высокоскоростная печать; Международная ассоциация автоматизации; Национальная система стандартов по

электротехнике (США); персональный компьютер (ПК); программируемый логический контроллер (ПЛК); пропорционально-интегрально-дифференциальное (ПИД) регулирование; протокол передачи гипертекстовых файлов; синхронный последовательный интерфейс; система автоматического контроля и управления производственными процессами; схема производственного процесса; схема прокладки трубопроводов и расположения контрольно-измерительных приборов (КИП); уровень полноты безопасности; класс надёжности и безопасности; функциональный блок; числовое программное управление (ЧПУ).

5 Answer the questions below:

1. What are the two types of process automation tools described in the passage?
2. What is the main advantage of RPA & other cognitive automation tools?
3. Why are RPA tools considered to be the most flexible type?
4. What is the main disadvantage of RPA tools?
5. Is it possible to draw the line between AI-augmented RPA bots and other intelligent bots?
6. What are the main features of low code application platforms?
7. What is the deference between RPA tools and low code applications?
8. Why do we need specialized process automation tools?
9. What lets IT departments spend less time on carrying out maintenance tasks?
10. How can you exemplify the importance of IT process automation?

6 Sum up the information about process automation tools you have learnt from the reading passage. Use the table below to help you:

Industrial Process Automation Tools		
general		specific
robotic process automation & cognitive automation	low code application platforms	IT process automation

Your summary should be about one-third of the original text.

Critical Thinking

7 RPA tools can also be classified into three types: attended, unattended and hybrid. Can you match the terms with their definitions below?

1. These tools are clever and have the capacity for decision-making.
2. These tools have both features of the two other types.
3. These tools involve human intervention during performing automation methods.

Can you give any examples of these three types?

8 Here is the list of 8 top RPA tools:

1. *Blue Prism*
2. *Inflectra Rapise*
3. *UiPath*
4. *Automation Anywhere*
5. *Pega*
6. *Nice system*
7. *Kryon*
8. *Linx*

Have you heard of any of them? Choose one tool from the list and surf the Internet to find some more information about it (You may find it useful to start with the links in the references).

Speaking

9 Give a two-minute talk about the benefits and drawbacks of the chosen RPA tool. Use the following plan for your presentation:

1. Definition of RPA
2. Advantages of a RPA tool
3. Disadvantages of a RPA tool
4. Conclusion

Translation Challenge

10 Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

Key points to remember when starting process automation

According to most experts, you should start in phases. You set some goals that you want to achieve through these RPA programs first. Then you test the initial small process automation to see if it matches those goals. If it doesn't, then you can try another program. You can cancel the trial easily before you make a big investment of time and money into overhauling your whole system.

Also, make sure every team member gets adequate training before you launch the new process automation tools. They have to understand how the entire process works. That way, they'll know how to resolve any unexpected problems that may come up during the transition phase.

Finally, you will need to make sure that your developer includes an "escape route" in your program for emergencies. A real human should have the ability to step in and take over the program at any time. You never know when you'll need to take charge so that business can continue as usual. Expect that sometimes unforeseen problems occur with the first automation.

(895 characters)

UNIT 3. COMPUTER NUMERICAL CONTROL

Before You Read

1 Read the following excerpt from a blog by cnccom. What is it about?

Computer numerical control is an extremely high-tech and important process in today's world of manufacturing. It takes skilled engineers to program the files used by the microprocessor within a machine tool to make a machine function properly and efficiently. It's amazing how quickly various goods can be produced, but CNC technology is an important backbone that makes all the difference in these processes.

Do you agree that CNC technology is the essence of modern industry? What do you think the benefits of computer numerical control are?

2 When you skim a reading passage, you read it quickly to learn about its content and organization. You don't read every word. Instead, your eyes

move very quickly over the selection, trying to find general information (e.g., the topic of a reading). Read the two questions below. Then, take **one minute** to skim the reading passage below for the answers. Discuss your answers with a partner.

1. What is the topic of the following reading passage?
2. Who is the audience for this reading?

3 Practice reading the words and word combinations:

abbreviated; contour; executed; facilitate; filament; grinder; lathe; microcomputer; numerical; parameter; repeatability; winding.

While You Read

4 Read the passage again. Pay attention to the words **in bold**. Copy them down into your *Vocabulary Notebook*.

Computer numerical control, commonly abbreviated as **CNC**, is a method for automating control of machine tools through the use of **software** embedded in a **microcomputer** attached to the tool. It is commonly used in manufacturing for machining metal and plastic parts.

With **CNC**, each object to be manufactured gets a **custom computer program**, usually written in an **international standard language** called **G-code**, stored in and executed by the **machine control unit** (MCU), a **microcomputer** attached to the machine. The **program** contains the instructions and parameters the machine tool will follow, such as the feed rate of materials and the positioning and speed of the tool's components. Mills, lathes, routers, grinders and lasers are common machine tools whose operations can be **automate**d with **CNC**. It can also be used to control non-machine tools, such as welding, electronic assembly and filament-winding machines.

Early in the process, engineers create a **computer-aided design (CAD)** drawing of the part to be manufactured, then translate the drawing into **G-code**. The **program** is loaded onto the **MCU** and a human **operator** performs a test run without the raw material in place, to ensure proper positioning and performance. This step is important because incorrect speed or positioning can damage both the machine and the part.

CNC is considered to provide more precision, complexity and repeatability than is possible with **manual** machining. Other benefits

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include greater accuracy, speed and flexibility, as well as capabilities such as **contour machining**, which allows milling of **contoured shapes**, including those produced in **3D designs**. On the other hand, **CNC** can be more expensive, require more maintenance than other production methods and compel companies to hire a skilled **CNC programmer**.

Some **CNC** systems are integrated with **CAD** and **computer-aided manufacturing** (CAM) software, which can speed the process of **program**ming the **MCU**. Integration with **ERP software** and related **applications**, such as **enterprise asset management software**, can facilitate **operational intelligence processes** and help improve plant performance and maintenance.

After You Read

5 Match the words from column A with the words from column B to make word combinations. Then translate these combinations into Russian.

A	B
CAD	abbreviated
commonly	assembly
contoured	computer program
custom	drawing
electronic	machining
embedded	material
feed	methods
human	operator
machine	parts
manual	performance
metal	rate
plant	shapes
production	software
raw	tools

6 Sum up the reading passage using the clichés. Your summary should be about **one-third of the original text**.

*The text explains the notion of computer numerical control. It can be divided into two logical parts. The first part is about ... . **...** In the second part the author writes about ... . **...***

Critical Thinking

7 A program for numerical control consists of a sequence of blocks that causes an NC machine to carry out a certain operation. A block is equivalent to a line of codes in a part program, e.g. N135G01X1.0Y1.0Z0.125T01F5.0. Can you match the following sections of the block from the example with their functions?

sections	functions
1) N135	
2) G01	a) block number
3) X1.0	b) coordinate
4) Y1.0	c) G-code
5) Z0.125	d) special function
6) T01	e) tool number
7) F5.0	

8 The reading passage underlines the importance of "a skilled CNC programmer" What training and skills do you think a specialist in automation needs? Discuss the issue with your partner and make a list of things you should learn to be successful in your future career.

Speaking

9 Give a two-minute talk about your ambitions in the future career. Use the following questions to plan your presentation:

1. Why have you chosen this profession?
2. What traits should a person interested in industrial automation have? Do you think you have these traits?
3. What education is necessary to be a good specialist in this area? Do people need any extra training, e.g. a good command of a foreign language?
4. Where would you prefer to work? Why?

Translation Challenge

10 Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

The basic concept behind numerical control apparently was implemented in the early 1800s, when punched holes in sheet-metal cards were used to automatically control the movements of weaving machines. Needles were activated by sensing the presence or absence of a hole in the card.

The principle of numerically controlling the movements of machine tools was first conceived in the 1940s by John Parsons in his attempt to machine complex helicopter blades. The first prototype NC machine was built in 1952 at the Massachusetts Institute of Technology. It was a vertical-spindle, two-axis copy-milling machine retrofitted with servomotors.

The numerical data to be punched into the paper tapes were generated by a digital computer, another invention that was being developed at the same time at MIT. In the experiments, parts were machined successfully, accurately, and repeatedly without operator intervention. Later, these machines were equipped with computer-numerical controls yielding greater flexibility, accuracy, versatility, and ease of operation.

UNIT 4. PROGRAMMABLE LOGIC CONTROLLERS

Before You Read

1 Find 15 hidden words and word combinations (spelt without spaces) from the previous units reading passages in the wordsearch below.

```
                    T E I
                I R C B X U U L T
            M M G O K K K K O Z D X C
        V C W Z N O F W B S Y K X E E H K
      N K I B T B V V G L W T T N J T B O A
    X K U G O A C R O B O T I C A N E H J P B
    U F W U Y N S E O J G S W K L R R H J X K
  S M W R E C A F R E T N I C C Z Y A I T X F T
  U G M W T U T R G C R O V M V S K E R P L F
M P Y L B M E S S A L K K Z G P B C P N K W I X V
A Z W A B C W M T K Q V Z U L K M R I F I N W C J
I M Q K E J F I H J T U Q B Z P G U X N B O Z C X
Y D P A B A O A H R W L C D A Y Q H P B O A I B R D N
M I R O N N B A Z S A T O M A L V X G F I K T U S O B
B R K C T U C H S U K M M T C Y E F N U T Y A J X G U
  S A Y L K F L N B X L P Q T W M I U R A J C K E L
  T U O Z L S A D G Q H U P U O L I M K M L I B Y L
  Z J G C F M E C Y E F T O A E O U E M O Z L A Z M
    G O K Y F I D T U S E R T J P L R Y T M P H B
    C U S T O M S K U A R J O Q S Y I C U E P D R
      E W D L J U T Q R A S R O H P C I A B A G
      K S M X O A Y P E I N B L C S A C J D N W
        N T X C W I K H D N P L Z S L Y J S E
          J B Q Z C I O E L G Q F W A L J I
            Z J N O M D B J Q J I B X
              J I D C O B T B O
                E U O
```

<u>2 To check youself give English eqvalents for the following words and word combinations:</u>

автоматизация; автоматизированный; заказной; исполнительное звено; контурный; малокодовый; настольный; приложение; производство; роботизированный; ручной; сборка; система обмена данными; средство; цифровой.

While You Read

<u>3 When you need to find specific information in a text, you should scan it, or move your eyes very quickly across the text without reading every word, stopping only to «pick up» the information you are looking for. Scan the text to find the specific information below. Remember to look quickly over the text without reading every word.</u>

1. What does PLC stand for?
2. In what meaning is the word "logic" used?
3. How do PLCs differ from computers?

A **programmable logic controller (PLC)** is a special form of **microprocessor-based controller** that uses a **programmable memory** to store instructions and to implement functions such as logic, sequencing, timing, counting and arithmetic in order to control machines and processes and are designed to be operated by engineers with perhaps a limited knowledge of **computer**s and **computing languages**. They are not designed so that only **computer programmers** can set up or change the programs. Thus, the designers of the **PLC** have pre-**program**med it so that the control **program** can be entered using a simple, rather intuitive, form of language. The term **logic** is used because **programming** is primarily concerned with implementing logic and switching operations, e.g. if A or B occurs switch on C, if A and B occurs switch on D. **Input devices**, e.g. sensors such as switches, and **output devices** in the system being controlled, e.g. motors, valves, etc., are connected to the **PLC**. The operator then enters a sequence of instructions, i.e. a **program**, into the **memory** of the **PLC**. The **controller** then monitors the **inputs** and **outputs** according to this **program** and carries out the control rules for which it has been **program**med.

PLCs have the great advantage that the same basic **controller** can be used with a wide range of **control systems**. To modify a **control system** and the rules that are to be used, all that is necessary is for an operator to key in a different set of instructions. There is no need to rewire. The result is a flexible, cost effective, system which can be used with **control systems** which vary quite widely in their nature and complexity.

PLCs are similar to **computers** but whereas **computers** are optimised for calculation and display tasks, **PLCs** are optimised for control tasks and the industrial environment. Thus **PLCs** are:

- rugged and designed to withstand vibrations, temperature, humidity and noise;
- have **interfacing** for **inputs** and **outputs** already inside the **controller**;
- are easily **program**med and have an easily understood **programming language** which is primarily concerned with **logic** and switching operations.

The first **PLC** was developed in 1969. They are now widely used and extend from small self-contained units for use with perhaps 20 **digital inputs/outputs** to modular systems which can be used for large numbers of **inputs/outputs**, handle **digital** or **analogue inputs/outputs**, and also carry out **proportional-integral-derivative control modes**.

4 Read the passage again. Pay attention to the words and word combinations **in bold**. Copy them down into your ***Vocabulary Notebook***.

After You Read

5 Match the words from column A with the words from column B to make word combinations. Then translate these combinations into Russian.

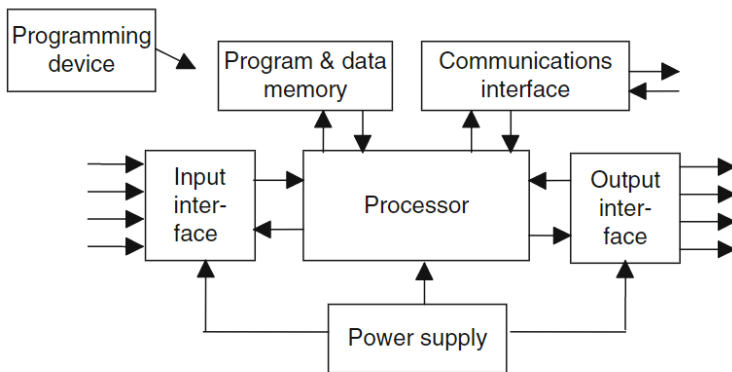| **A**	**B**
carry out	control modes
control	functions
develop	humidity
enter	inputs/outputs
implement	instructions
modify	machines or processes
monitor	a PLC
set up	a program
store	rules
withstand	a sequence of instructions

6 Answer the questions below:

1. What is a programmable logic controller?
2. What are PLCs used for?
3. Why are PLCs pre-programmed to be used by any operator?
4. What are inputs/outputs?
5. What is the working principle of a PLC?
6. What is the major benefit of PLCs?
7. What are primary features of PLCs?
8. What are PLCs now used for?

<u>7 Sum up the reading passage using the clichés. Your summary should be</u>
<u>about one-third of the original text.</u>

The text is devoted to the notion of a programmable logic controller. It can be divided into two logical parts. In the first part the author defines the term and explains how PLCs work. … The second part is about the usage of PLCs in industrial automation. …

Critical Thinking

<u>8 Typically a PLC system has the basic functional components of</u>
<u>processor unit, memory, power supply unit, input/output interface</u>
<u>communications interface and the programming device. Study the</u>
<u>diagram and match the PLC components with their functions.</u>

components	functions
The input section The memory unit The output section The power supply unit The processor unit The programming device	a) to communicate information to external devices; b) to convert the mains a.c. voltage to the low d.c. voltage (5 V) necessary for the processor and the circuits in the input and output interface modules; c) to enter the required program into the memory of the processor; d) to interpret the input signals and carry out the control actions, according to the program stored in its memory, communicating the decisions as action signals to the outputs; e) to receive and transmit data on communication networks from or to other remote PLCs; f) to receive information from external devices; g) to store the program which is used for the control actions to be exercised by the microprocessor and data stored from the input for processing and for the output for outputting.

Speaking

9 The first PLC was developed in 1969. Surf the Internet and give a brief report about the history of PLCs development (You may find it useful to start with the links in the references).

Translation Challenge

10 Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

Distributed Control Systems (DCS) plays a vital role in manufacturing, production industries as they are used to control and manage the processes.

DCS are extension of traditional controllers. The major concept of distributed control systems application is derived from the idea of decentralizing the control unit and establishing a common network between the operator, engineering stations.

DCSs tend to be used on large continuous process plants where high reliability and security is important, and the control room is not

geographically remote. DCSs are connected to sensors and actuators and use set point control to control the flow of material through the plant. Although 4–20 mA has been the main field signalling standard, modern DCS systems can also support field bus digital protocols, such as Foundation Fieldbus, profibus, HART, Modbus, PC Link, etc., and other digital communication protocols such as modbus.

<div align="right">(783 characters)</div>

UNIT 5. FUTURE AUTOMATION TRENDS

Before you read

1 Discuss the following questions with your partner.

1. What does AI stand for?
2. What is the definition of artificial intelligence?
3. Who coined the term AI?
4. Does AI exist?
5. Can AI be dangerous?
6. How will AI change the future?
7. Why do we need AI?
8. What are the typical jobs related to AI?
9. Which are the most powerful AI companies?
10. What types of AI applications are currently in use for industrial automation?

2 International Scientific Vocabulary is a part of the vocabulary of the sciences and other specialized studies that consists of words or other linguistic forms current in two or more languages and differing from New Latin in being adapted to the structure of the individual languages in which they appear. For example, it is easy to guess about the meaning of the word 'product', because we have the analogues of the same root in Russian. Try to guess the meanings of the words below without looking them up in the dictionary:

a) atom, atomic, atomism, atomize, atomically, atomically, atomist;
b) cable, cablese, cabling;
c) centre, central, centric, centrically, centring, centrist, centreless;

d) computer, computerese, computerize, computerize, computerlike, computer;

e) copy, copyist, copying, copier, miscopy;

f) design; designed, designer, designing, designful, redesign, designable, overdesign;

g) machine, machinist, machinable, machinery; machining;

h) operation, operational, disoperation;

i) test, tester, testify, tested, testing, retest.

3 Copy down the words from the reading passage below that belong to the International Vocabulary. Give their Russian equivalents.

While you read

4 Take **one minute** to skim the reading passage below for the answers. Discuss your answers with a partner.

1. What is the topic of the following reading passage?
2. Who is the audience for this reading?
3. How many headings does the author use?
4. Why do you think the author chose to use them?

5 Scan the text to answer the following questions:

1. What promising automation technologies are analysed in the reading passage?
2. What companies have developed new software to assist engineers in improving industrial automation?
3. How can a "cobot" be defined?

6 Read the passage. Pay attention to the words **in bold**. Copy them down into your ***Vocabulary Notebook***.

Accenture forecast the Industrial Internet of Things could contribute $10 trillion to the global economy by 2030. As of now, numerous companies claim to assist **industrial equipment operator**s and engineers in aspects of their roles from operating and maintaining machinery to improve factory processes.

This report covers companies offering **software** across two technologies:

1. **Industrial Internet of Things (IIoT)**:
the **network** that connects, collects, communicates, and monitors devices to **enhance industrial processes**

1.1 *Siemens* is a German company that offers a **software** called *MindSphere*, a **cloud-based operating system** that enables machines and equipment inside a plant to **collect data**. Siemens claims that **sensors gather data** from various machines and **upload** them to the company's **database** in the **cloud**. This **data** is then run through *MindSphere*'s **machine learning algorithm** to inform **analytics** on a **dashboard**. *MindSphere* may also **run diagnostics** on the underperforming machine. Once the **machine learning model** behind it finds the problem, the *MindSphere* may inform **machine maintenance operators** about the problem and recommend either to fix or retire the machine.

1.2 *IBM* offers *IBM Watson*, which it claims can help mining companies potentially reduce drilling costs, improve predictions about mineral explorations, and accelerate geological insights using **image recognition** and **machine learning**. IBM claims the **application** enables geologists to conduct subsurface analytics around geoscience **data interpretation**, reservoir exploration, and mineral exploration. To do this, users may **enter a query** into the **platform**'s **search interface**. The **search engine's algorithms** will then run the keywords through the geological data **repository**, which contains **structured and unstructured data** from a variety of sources, such as the drill **database**, block models, geochemistry, geological shapefiles, core photos, and X-Ray fluorescence **data**. The system then returns predictions about the mineral content as a graph.

1.3 *General Electric* offers *Brilliant Factory*, a suite of **hardware assets**, **software**, and consultation services for upgrading factories to **industrial IoT**. *GE* claims that using the **data-driven** *Brilliant Factory* suite could reduce costs, improve the quality of products and services, and expedite the production process. The **platform** enables businesses to monitor the health and performance of factory machinery and equipment and manage the production process. This is done by connecting machinery and equipment to a single **network**, **implement**ing **sensors** on each machine, and **collecting** the **structured** and **unstructured data** in a **database** where it is stored and organized. The company claims the

software works with **data** from all types of equipment from all different industries.

<div align="center">

2. **Collaborative robots, or cobots**:

robots designed to work with humans

</div>

Rethink Robot offers *Sawyer*, a **collaborative robot (cobot)** that runs on **software** called *Intera*. The company claims that *Sawyer* can help manufacturers achieve better productivity and higher-quality products using the **machine vision**. Rethink Robots claims that *Sawyer* is **embed**ded with the *Cognex Vision System*, which enables it to detect objects or inspect parts with **object detection** technology. This **vision system** captures images of items to be handled and transmitted to the *Robot Positioning System*, an **application** that looks for changes in the robots' environment and enables the **user** to **adjust its settings**. **Users** can also integrate external cameras into the **cobot**.

After you read

7 For each item below choose the best answer:

l. The subject of the text is:
a) to contrast and compare different industrial automation applications;
b) to inform the reader about the developed technologies that are forecast to be of great importance in the future;
c) to describe the capabilities of new methods to collect structured and unstructured data.
2. The passage can be split into:
a) two logical parts;
b) three logical parts;
c) four logical parts.
3. The first logical part is about:
a) forecasts concerning the automation of factory processes;
b) the importance of modern developments;
c) industrial equipment improvement.
4. The second logical part:
a) presents digitalization achievements of some companies;
b) advertises new software;
c) explains what the Internet of Things is.
5. The final part focuses on:

a) object detection software;
b) a machine vision application;
c) better productivity of cobots.

8 Sum up the text using the flowchart below:

1	The subject of the	text / passage		is __ .	
	The	text / passage	tells us about / describes / is devoted to	__ .	
	The	text / passage		is about __ .	
	This	text / passage	deals with	the problem of ___ . / ___ .	
2	The	text / passage	can be	divided / subdivided / split	into ___ logical parts.
	The	text / passage		falls into ___ logical parts.	
3	The	first / second / third / fourth / fifth	part	is about / describes / is devoted to / analyses / points out	___ .
	In the	first / second / third	part	the author	writes about / analyses the problem of / gives his point of view on	__ .
	Attention is concentrated on ___ in the	first / second / third	part.		

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4	By way of summing up, I can say that ___ .		
	In conclusion, I want to say that ___ .		
	To my mind	the text	is of great interest as ___ .
		passage	
	I think it is	informative	because ___ .
		interesting	
		difficult to read	

Critical Thinking

9 Proper names are names for an individual person, place, or organization, etc., having an initial capital letter. There is no doubt that translating proper names can be very troublesome in practice because there is no unified scheme to translate proper names (e.g. *Charles→* a) *Карл*, b) *Чарльз*). We can use several ways to translate names from Russian into English: **transliteration** (representing the characters of a given script by the characters of another, e.g. *George→Георг*), **transcription** (converting the characters of one language to the characters of another language in accordance with the pronunciation of the target language, e.g. *Newfoundland→ Ньюфаундленд* and **calquing** (translating morphemes or words, e.g. *Rocky Mountains→Скалистые горы).* Complete the table below:

English	a way to translate	Russian
Dr. Watson	transliteration	доктор Ватсон
Salt Lake City	transcription	Солт-Лейк-Сити
Lake Superior	calquing	Озеро Верхнее
Cognex Vision System Cognex Vision System	transliteration calquing	видеосистема Когнекс (компания) Когнекс видеосистема
IBM	transcription	(компания) Ай-Би-Эм
GE Brilliant Factory		
General Electric		
IBM Watson		
Intera		
MindSphere		

Rethink Robot		
Robot Positioning System		
Sawyer		
Siemens		

Translation Challenge

10 Translate the following passage from English into Russian, read out your translation to your groupmates, listen to theirs and vote for the best one.

Hyperautomation starts with robotic process automation at its core, and expands automation capability with artificial intelligence, process mining, analytics, and other advanced tools. Hyperautomation unlocks maximum potential for an automated enterprise:

•　Artificial intelligence capabilities such as machine learning, natural language processing, intelligent optical character recognition, and AI computer vision, so robots can read, see, and process more work .

•　Automated process discovery tools that look deeply into how your teams work to show you what you can and should automate.

•　Workforce engagement capability: ways to enable everyone in an organization to contribute to automation. Involve not just the traditional RPA developers and testers, but also involve your subject matter experts, business analysts, and business users.

•　Advanced analytics to measure and demonstrate the ROI of　automation and its impact based on business　outcomes that matter to your company.

(864 characters)

UNIT 6. VOCABULARY REVISION

Try to do the tasks below on your own.

If you find it difficult, look through the reading passages

or refer to your *Vocabulary Notebook*.

1 Translate the following related words into Russian:

a) automate (v); automated (adj); automatically (adv); automation (n);
b) assemble (v); assembly (n); subassembly (n);
c) operation (n); operator (n); operational (adj);
d) program (v); programmable (adj); programmer (n); programming (n).

2 Match the terms with their definitions. Give their Russian equivalents.

1. application	a) a computer network where files and programs can be stored, especially the Internet
2. cloud	b) a computer program that is designed for a particular purpose
3. controller	c) a connection between two pieces of electronic equipment, or between a person and a computer
4. device	d) a device that discovers and reacts to changes in such things as movement, heat, and light
5. hardware	e) a device used to operate or control a machine
6. interfacing	f) a group of computers that are connected and can share information
7. logic	g) a particular computer technology that can be used with some types of software programs but not with others
8. memory	h) a small part containing a microprocessor
9. microcomputer	i) actions that a computer performs, such as comparing and matching, that involve simple yes or no choices, rather than more complicated mathematics
10. network	j) an object or machine that has been invented for a particular purpose
11. platform	k) someone who uses a product, machine, or service
12. sensor	l) the part of a computer in which information or programs are stored either permanently or temporarily
13. software	m) the physical and electronic parts of a computer

14. user	n) the programs that you put into a computer to make it do particular jobs

2 Match the words with their Russian equivalents:

a) nouns:

1. accuracy	a) актив, фонд
2. actuator	b) база данных
3. asset	c) контроль
4. capability	d) настольный ПК
5. dashboard	e) приборная панель
6. database	f) производительность; объем
7. desktop	g) способность; возможность
8. facility	h) техническое средство
9. inspection	i) техобслуживание
10. maintenance	j) точность
11. throughput	k) управляющее устройство

b) verbs:

1. adjust	a) внедрять; встраивать
2. automate	b) внедрять; реализовывать
3. collect / gather	c) загружать
4. develop	d) корректировать
5. embed	e) модернизировать
6. enhance	f) оптимизировать; совершенствовать
7. implement	g) проводить; осуществлять
8. run	h) разрабатывать
9. store	i) собирать
10.upload	j) хранить

c) adjectives:

1. advanced	a) дополненный; комбинированный
2. analogue	b) использующий большие данные

3. augmented	c) моделирующий; аналоговый
4. custom	d) неавтоматизированный
5. data-driven	e) специально разработанный; индивидуализированный
6. digital	f) усовершенствованный; с улучшенными возможностями
7. manual	g) цифровой

3 Match the verbs with nouns and then translate the word combinations into Russian.

verbs	nouns
adjust	application
automate	data × **3**
collect gather	diagnostics
develop	processes
enhance	settings
run	tasks
store	
upload	

4 Translate into Russian the following two-word terms:

automation module, automation tool, business unit, cognitive bot, computing language, contour machining, contoured shape, control system; data interpretation, data repository, hard automation, image recognition, industrial robot, input device, intelligent bot, machine learning, manufacturing cell, object detection, output device, process automation, process orchestration, product flow, screen scraping, search interface, server provision, soft automation, specialized equipment, structured data, unstructured data, vision system.

5 What do these abbreviations stand for? Give their Russian equivalents.

AC, AI, API, CAD, CAE, CAM, CIM, CNC, ERP, GUI, IoT, ITPA, MCU, OCR, PLC, RPA, UI, UX.

6 Translate into English the following terms using the abbreviations:

a) **G**: код подготовительной функции;

b) **IT**: информационный отдел, сотрудники (персонал) информационного отдела, специалист (профессионал) в области информационных технологий,

c) **RPA**: программа-робот для роботизированной автоматизации процессов, программное обеспечение с элементами искусственного интеллекта и машинного обучения, система для робототехнической автоматизации технологических процессов и производств.

7 Word combinations with terms should be translated starting with the **main word** which is usually the final component, e.g. *least squares method – способ наименьших квадратов*. Translate into Russian the following word combinations:

automated material-handling system; business function specific automation; cloud-based operating system; cognitive automation tool; computer-controlled machinery; computer-integrated manufacturing system; drag & drop programming interface; end-to-end process management; enterprise asset management software; flexible manufacturing systems; industrial equipment operator; international standard language; low code application platform; low level instruction; machine learning algorithm; machine learning model; microprocessor-based controller; natural language processing; numerically controlled machine; operational intelligence processes; proportional-integral-derivative control mode; search engine's algorithm; specialized process automation tools.

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СОДЕРЖАНИЕ

ИНОСТРАННЫЙ ЯЗЫК

АВТОМАТИЗАЦИЯ ТЕХНОЛОГИЧЕСКИХ ПРОЦЕССОВ
И ПРОИЗВОДСТВ В МЕТАЛЛУРГИЧЕСКОЙ ПРОМЫШЛЕННОСТИ
ENGLISH FOR SPECIFIC PURPOSES
METALLURGICAL PROCESS CONTROL AND AUTOMATION

Методические указания к практическим занятиям
для студентов бакалавриата направления 15.03.04

Сост.: *С.А. Свешникова, М.А. Троицкая*

Печатается с оригинал-макета, подготовленного кафедрой
иностранных языков

Ответственный за выпуск *С.А. Свешникова*

Лицензия ИД № 06517 от 09.01.2002

Подписано к печати 08.02.2023. Формат 60×84/16.
Усл. печ. л. 2,1. Усл.кр.-отт. 2,1. Уч.-изд.л. 1,9. Тираж 50 экз. Заказ 91.

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