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PROFESSIONALLY ORIENTED FOREIGN (ENGLISH) LANGUAGE

Methodological guidelines for performing term papers

for students majoring in specialty 5B070200 – Automation and control
(Part I)

Almaty 2017

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The present methodological guidelines are intended for the 3-rd year students of specialty 5B070200 – Automation and control for performing term paper 1 on the discipline "Professionally oriented foreign (English) language". Special attention is drawn to the translation of authentic professional texts, compilation of terminological vocabulary, as well as doing lexical and grammar exercises. Key-patterns and instructions on writing summaries to the texts are also given.

References- 5 items.

Reviewer: V.S. Kozlov, AUPET associate professor, cand. ph. Sc., department for language studies

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Introduction

Self-study of the student is aimed at individual fulfillment of academic assignments, generating cognitive interest, extending knowledge in the area of professional occupation through language-learning practice.

Term paper 1 (SSA – self-study assignment) consists in written translation of professionally-oriented texts with volume of no less than 3,000 symbols each, compiling a terminological glossary, and fulfillment of lexical and grammar assignments, and tasks for monitoring comprehension of the text, including writing of an abstract or a summary.

Generally, a term paper should be written in out of class conditions, in accord with the suggested list of topics and the teacher's assignments. One of the main tools for understanding the text content is its lexical and grammatical analysis which is applied while reading and checked in the process of fulfillment of the assignments.

Term paper assignments:

1) Translate text 1 from English into Russian (volume – 3,000 symbols).

2) Compile a terminological glossary (list) reflecting most important terms and concepts with word definition, synonym/antonym and translation, decode abbreviations (no less than 20 per term paper).

3) Fulfill the tasks on text comprehension: make up 10 questions.

4) Fulfill the tasks on vocabulary and grammar.

5) Write a summary to text 2 in English and in Russian.

Criteria for evaluating translation skills (professionally oriented texts):

- volume of the material worked up;
- currency and relevance of the text (to the profile of the chosen discipline);
- logical sequencing and clear presentation;
- terminological style and grammar accuracy;
- abilities and skills of text analysis, generalizing, organization and delivery of factual information;
- argumentation, support and conclusion.

Work on the term paper (TP 1) starts on the first week of the semester, and the completed paper must be submitted on the 5th week.

The title page should be formatted according to the standard accepted in the University (consult the teacher).

It is also required to compile a student's vocabulary book. The format may be free, or you can use the sample of a vocabulary log presented here or choose any other suitable from the Internet.

Sample Vocabulary Log.
Table 1

Word or concept/	Part of speech/ Word Definition	Transcription/ Translation	Sentence or phrase using the word
Router.	A noun. A *router* is a networking device that forwards data packets between computer networks. A router is connected to two or more data lines from different networks (as opposed to a network switch, which connects data lines from one single network.	Маршрутиза́тор (*проф. жарг.* ра́утер, ру́тер (от англ. *router* /ruːtə(r)/ или /raʊtɚ/) или ро́утер (транслитерация английского слова)	… a connecting device such as a router, which connects the network to other networks

It is important: while interpreting and translating terms (concepts, words and phrases) it should be shown exactly what value and meaning they have in the particular text (the context).

It is preferable that all the work done by the student within the discipline "Professionally oriented English language or English for special purposes" should be recognized (recorded) in a special folder (portfolio).

To write *a summary* you should use the following key-expressions:
The text/article under review…gives us a sort of information about…
The article deals with the problem…
The subject of the text is…
The text is about…

At the beginning (of the text) the author describes…(dwells on…; explains…; touches upon…; analyses…; comments…;characterizes…; underlines…; reveals…; gives account of...)
The article begins with the description of…; a review of…; the analysis of...
The article opens with…

Then (after that, further on, next) the author passes on to…; gives a detailed (thorough) analysis (description); goes on to say that…

To finish with (in conclusion, to sum up), the author describes…
At the end of the article, the author draws the conclusion that…the author sums it all up (by saying…)
In conclusion the author…

1 Unit № 1

1.1 Read and translate the text. Use a dictionary to help you.

Automation

In its ideal form, automation implies the elimination of all manual labor through the use of automatic controls that ensure accuracy and quality. Although perfect automation has never been achieved, in its more-limited form it has caused alterations in the patterns of employment.

Coined in the 1940s at the Ford Motor Company, the term *automation* was applied to the automatic handling of parts in metalworking processes. The concept acquired broader meaning with the development of cybernetics by American mathematician Norbert Wiener. Through cybernetics, Wiener anticipated the application of computers to manufacturing situations. He caused alarm during the 1950s and ’60s by suggesting, erroneously, that automatic machinery would lead to mass unemployment. But automation was not introduced as rapidly as foreseen, and other economic factors have created new opportunities in the labor market.

Automation evolved from three interrelated trends in technology: the development of powered machinery for production operations, the introduction of powered equipment to move materials and work pieces during the manufacturing process, and the perfecting of control systems to regulate production, handling, and distribution.

Devices to move materials from one workstation to the next included conveyor-belt systems, monorail trolleys, and various pulley arrangements. The transfer machine, a landmark in progress toward full automation, moves the work pieces to the next workstation and accurately positions them for the next machine tool. It cuts labor costs and improves quality by ensuring uniformity and precision. The first known transfer machine was built by an American firm, the Waltham Watch Company, in 1888; it fed parts to several lathes mounted on a single base. By the mid-20th century, transfer machines were widely employed in the automotive industry, appliance manufacturing, electrical-parts production, and many other metalworking industries.

Automatic controls revolutionized all aspects of the production process. Starting in the 19th century, the simple cam could automatically adjust the position of a lever or machine element. But cam devices were limited in speed, size, and sensitivity. True automatic control can occur only when the machine is sensitive enough to adjust to unpredictably varying conditions. This requirement demands instant responses to feedback—something a computer can perform in a fraction of a second.

Whereas industrialization made possible the mass production of identical parts for mass markets, the computer allowed for custom-made small-batch production. During the 1980s and ’90s, American firms made significant investments in information-processing equipment. These developments allowed American manufacturers to concentrate on “niche” production—that is, supplying a limited segment of the market with a specialized product and responding speedily to changes in market demand. On the automobile assembly line, niche production enables many cars containing different options to be fabricated on the same assembly line, with computers monitoring a system that ensures the proper items will go into each separate car.

Further developments in automation created two new fields: computer-aided design (CAD) and computer-aided manufacturing (CAM), often linked as codisciplines under the title CAD/CAM. In a sense, CAD/CAM allows the mass production system to manufacture customized “handmade” articles. The machinery can be adapted to a particular product through computer programming, enabling work on small batches to achieve many of the economies previously available only through mass production of identical objects. Computer-aided design itself makes possible the testing of production methods and the design of the product by running tests (of such factors as ability to withstand stress, for example) through the computer. After testing, the product design or the process can be modified without going to the expense and time required for building actual prototype models.

Automation not only gives flexibility to production but also can cut down costly lead times confronted when changing from one production model to another and it can control inventories to provide a continuous flow of materials without expensive storage requirements or investment in spare parts. Such efficiencies lower production costs and help explain the growing strength in world markets of the Japanese, who first introduced the practice. Automation has also fostered the development of systems engineering, operations research, and linear programming.

Automation has not yet reached the level of completely robotized production. The first generation of industrial robots could perform only simple tasks, such as welding, for they became confused by slight differences in the objects on which they worked. To overcome that difficulty, computer scientists and engineers began developing robots with keener sensitivity, thereby enlarging their capabilities. Although progress has been made, it is clear that human beings must be available to back up the robots and maintain their productivity.

Vocabulary

1.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

1.3 Choose the word of opposite meaning:

empty	a) proper, b) full, c) dry, d) total
to destroy	a) to arouse, b) to cut, c) to build, d) to heat
to assemble	a) to part, b) to cover, c) to beat, d) to manufacture
to remain	a) to place, b) to leave c) to stay d) to put up
complicated	a) advanced, b) permanent, c) huge, d) simple
tremendous	a) great, b) small, c) main, d) concrete
to damage	a) to tie, b) to shape, c) to heat, d) to restore
strength	a) weakness, b) crowd, c) hole, d) brick
easy	a) flat, b) difficult, c) main, d) similar

1.4 Put each verb in brackets into a suitable passive form:

1) I am sorry, madam, but this carpet (already sell) ________. 2) The old house on the corner (knock down) _________ last year. 3) When exactly (John give)_______ his prize? 4) Most people agree that America (not discover) _______ by Christopher Columbus. 5) All complaints about products (deal with) __________ by our customer services department. 6) Police confirmed that the murder weapon (since discover) __________ in a nearby lake. 7) It (announce) ________ yesterday that the government has decided not to raise income tax. 8) Good news! I (ask) _________ to take over as the new manager. 9) I do not believe that this play (write) _________ by Shakespeare. 10) Ann really likes (invite) __________to dinner parties.

Comprehension Check

1.5 Make up no less than 10 questions to text 1.

1.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Principles and theory of automation

An automated system is designed to accomplish some useful action, and that action requires power. There are many sources of power available, but the most commonly used power in today's automated systems is electricity. Electrical power is the most versatile, because it can be readily generated from other sources (e.g., fossil fuel, hydroelectric, solar, and nuclear) and it can be readily converted into other types of power (e.g., mechanical, hydraulic, and pneumatic) to perform useful work. In addition, electrical energy can be stored in high-performance, long-life batteries.

The actions performed by automated systems are generally of two types: (1) processing, (2) transfer and positioning. In the first case, energy is applied to accomplish some processing operation on some entity. The process may involve the shaping of metal, molding of plastic, switching of electrical signals in a communication system, or processing of data in a computerized information system.

All these actions entail the use of energy to transform the entity (e.g., the metal, plastic, electrical signals, or data) from one state or condition into another more valuable state or condition. The second type of action—transfer and positioning—is most readily seen in automated manufacturing systems designed to perform work on a product. In these cases, the product must generally be moved (transferred) from one location to another during the series of processing steps. At each processing location, accurate positioning of the product is generally required. In automated communications and information systems, the terms transfer and positioning refer to the movement of data (or electrical signals) among various processing units and the delivery of information to output terminals (printers, video display units, etc.) for interpretation and use by humans.

2 Unit № 2

2.1 Read and translate the text. Use a dictionary to help you.

Effect on skilled labor

Robotic machines can perform certain unpleasant and dangerous jobs such as welding or painting. They can handle loads of up to a ton or more and work efficiently in temperatures ranging from near freezing to uncomfortably hot. In many cases, automation has eliminated physical and mental drudgery from human labor and has allowed the worker to change from a machine operator to a machine supervisor. Automation also boosts productivity (as measured in output per man-hour), even as it reduces the number of workers required for certain tasks. In the 1950s and ’60s, for example, productivity increased while employment decreased in the chemical, steel, meatpacking, and other industries in developed countries. Except in the rust belt regions (older industrial areas in Britain and the United States), no mass unemployment has ever materialized. Instead, as certain jobs and skills became obsolete, automation and other new technologies created new jobs that call for different skills.

Automation has brought about changes in the worker’s relationship to the job. Here the differences between labor practices in different countries prove instructive. The scientific management principle of breaking work down into small, repetitive tasks was based perhaps upon the notion that the worker does not think on the job.

For example, when American factories became mechanized, the workers were not permitted to stop the assembly line if anything went amiss; that was the task of supervisory personnel. This led to low productivity and poor quality control. By comparison, workers in Japanese factories were allowed to stop the process when something went wrong. Workers were assigned to “quality circles,” groups that could give workers a say in the performance of their tasks and in the process of problem solving. This approach represents an application of Mayo’s Hawthorne effect—something Japanese managers had learned from American management consultants such as W. Edwards Deming. By encouraging workers to participate in the quality control efforts, the management approach improved both productivity and quality.

A similar way of enhancing quality and work performance is what is known as group assembly, which started in Swedish automobile plants and was also adopted by the Japanese and then by the Americans. With this system, a group of workers is responsible for the entire product (as opposed to individual workers who perform only one small task). If something goes wrong on an assembly line, any worker can push a button and hold things in place until the problem is resolved.

As this approach is increasingly employed throughout the world, it brings major changes to the labor force and to labor-management relations. First, it allows smaller numbers of more highly skilled workers, operating sophisticated computer-controlled equipment, to replace thousands of unskilled workers in assembly-line plants. Consequently, the highly skilled worker, whose talents had been lost on the old-fashioned assembly line, has again become indispensable. The proliferation of automated machinery and control systems has increased the demand for skilled laborers and knowledgeable technicians who can operate the newer devices. As a result, automation may be seen as improving efficiency and expanding production while relieving drudgery and increasing earnings—precisely the aims of Frederick W. Taylor at the turn of the 20th century.

The office work place

Office automation represents a further mechanization of office work, a process that began with the introduction of the typewriter and the adding machine in the 19th century. The introduction of computers also affected the organization of work in the information sector of the economy. Just as automated machinery has done away with the jobs of many machine operators, integrated information-processing systems have eliminated many clerical tasks. For the production operation, automation provides an exact control over the inventory of raw materials, parts, and finished goods. Applied to billing operations in the office, it often can drastically reduce accounting costs.

The combination of computers and telecommunications led some to believe that office workers would perform their required functions without leaving their homes, as the computer terminal would take the place of their usual paperwork. Such predictions for “telecommuting” generally have not materialized, however.

Social psychologists explain this by pointing out the social aspect of the work process, in the office as well as on the assembly line. Workers are, after all, social beings who benefit from interactions with their fellow employees.

Vocabulary

2.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

2.3 Choose the word of similar meaning:

a great deal	a) quantity b) plenty of c) according to d) consist of
to promote	a) to need b) to require c) to receive d) to facilitate
to replace	a) to load b) to cross c) to change d) to include
to suppose	a) to like b) to find out c) to try d) to think
to solve	a) to develop b) to consider c) to decide d) to send
invention	a) century b) influence c) size d) discovery
to supply	a) to sail b) to maintain c) to provide d) to move
to design	a) to point b) to construct c) to test d) to drive
between	a) round b) among c) in spite of d) through

2. 4 Choose the most suitable word or phrase in each sentence:

1) I will finish the letter now and you can post it ______ (after/later). 2) I have not seen Jim _______ (before/since) we worked together in London. 3) What were you doing ___________ (last evening/yesterday evening) when I called? 4) Did you live here _______ (in/since) 2008? 5) Diana has not finished her course ________ (already/yet). 6) What do you usually do ___________ (in the afternoon/this afternoon). 7) Have you seen Jean and Chris _____________ (nowadays/recently)? 8) Helen arrived here _____________ (at Thursday night/on Thursday night). 9) It's really ages _________(since/when) I saw you last. 10) Ann is going to be famous _________ (once/one day).

Comprehension Check

2.5 Make up no less than 10 questions to text 1.

2.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Feedback control

Feedback controls are widely used in modern automated systems. A feedback control system consists of five basic components: (1) input, (2) process being controlled, (3) output, (4) sensing elements, and (5) controller and actuating devices. The term closed-loop feedback control is often used to describe this kind of system.

The input to the system is the reference value, or set point, for the system output. This represents the desired operating value of the output. Using the previous example of the heating system as an illustration, the input is the desired temperature setting for a room. The process being controlled is the heater (e.g., furnace). In other feedback systems, the process might be a manufacturing operation, the rocket engines on a space shuttle, the automobile engine in cruise control, or any of a variety of other processes to which power is applied. The output is the variable of the process that is being measured and compared to the input; in the above example, it is room temperature.

The sensing elements are the measuring devices used in the feedback loop to monitor the value of the output variable. In the heating system example, this function is normally accomplished using a bimetallic strip. This device consists of two metal strips joined along their lengths. The two metals possess different thermal expansion coefficients; thus, when the temperature of the strip is raised, it flexes in direct proportion to the temperature change. As such, the bimetallic strip is capable of measuring temperature. There are many different kinds of sensors used in feedback control systems for automation.

The purpose of the controller and actuating device in the feedback system is to compare the measured output value with the reference input value and to reduce the difference between them. In general, the controller and actuator of the system are the mechanisms by which changes in the process are accomplished to influence the output variable. These mechanisms are usually designed specifically for the system and consist of devices such as motors, valves, solenoid switches, piston cylinders, gears, power screws, pulley systems, chain drives, and other mechanical and electrical components. The switch connected to the bimetallic strip of the thermostat is the controller and actuating device for the heating system. When the output (room temperature) is below the set point, the switch turns on the heater. When the temperature exceeds the set point, the heat is turned off.

3 Unit № 3

3.1 Read and translate the text. Use a dictionary to help you.

Machine programming

The programmed instructions determine the set of actions that is to be accomplished automatically by the system. The program specifies what the automated system should do and how its various components must function in order to accomplish the desired result. The content of the program varies considerably from one system to the next. In relatively simple systems, the program consists of a limited number of well-defined actions that are performed continuously and repeatedly in the proper sequence with no deviation from one cycle to the next. In more complex systems, the number of commands could be quite large, and the level of detail in each command could be significantly greater. In relatively sophisticated systems, the program provides for the sequence of actions to be altered in response to variations in raw materials or other operating conditions.

Programming commands are related to feedback control in an automated system in that the program establishes the sequence of values for the inputs (set points) of the various feedback control loops that make up the automated system. A given programming command may specify the set point for the feedback loop, which in turn controls some action that the system is to accomplish. In effect, the purpose of the feedback loop is to verify that the programmed step has been carried out. For example, in a robot controller, the program might specify that the arm is to move to a designated position, and the feedback control system is used to verify that the move has been correctly made.

Some of the programmed commands may be executed in a simple open-loop fashion—i.e., without the need for a feedback loop to verify that the command has been properly carried out. For example, a command to flip an electrical switch may not require feedback. The need for feedback control in an automated system might arise when there are variations in the raw materials being fed into a production process, and the system must take these variations into consideration by making adjustments in its controlled actions. Without feedback, the system would be unable to exert sufficient control over the quality of the process output.

The programmed commands may be contained on mechanical devices (e.g., mechanical cams and linkages), punched paper tape, magnetic tape, magnetic disks, computer memory, or any of a variety of other media that have been developed over the years for particular applications. It is common today for automated equipment to use computer storage technology as the means for storing the programmed commands and converting them into controlled actions. One of the advantages of computer storage is that the program can be readily changed or improved. Altering a program that is contained on mechanical cams involves considerable work.

Programmable machines are often capable of making decisions during their operation. The decision-making capacity is contained in the control program in the form of logical instructions that govern the operation of such a system under varying circumstances. Under one set of circumstances, the system responds one-way; under different circumstances, it responds in another way. There are several reasons for providing an automated system with decision-making capability, including (1) error detection and recovery, (2) safety monitoring, (3) interaction with humans, and (4) process optimization.

Error detection and recovery is concerned with decisions that must be made by the system in response to undesirable operating conditions. In the operation of any automated system, malfunctions and errors sometimes occur during the normal cycle of operations, for which some form of corrective action must be taken to restore the system. The usual response to a system malfunction has been to call for human assistance. There is a growing trend in automation and robotics to enable the system itself to sense these malfunctions and to correct for them in some manner without human intervention. This sensing and correction is referred to as error detection and recovery, and it requires that a decision-making capability be programmed into the system.

Vocabulary

3.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

3.3 Match the words in the left column with their interpretation proposed on the right:

1) Analog computer	a) a combination of interconnected circuit elements produced in a chip to perform a definite function;
2) Computer	b) a sequence of instructions enabling the computer to solve a given task;
3) Digital computer	c) a tiny piece of silicon containing complex electronic circuits used inside all computers;
4) Hardware	d) a system which processes and stores great amount of data solving problems of numerical computation;
5) Program	e) a device which can carry out routine mental tasks by performing simple operations at high speed;
6) Software	f) electronic and mechanical equipment in a computer system;
7) Programming	g) a set of programs, procedures and associated documentation;
8) Integrated circuit	h) the process of preparation a set of coded instructions for a computer;
9) Chip	i) a device that has input and output represented in the form of physical quantities;

10) Transistor	j) a small piece of a semiconductor that greatly reduced power consumption of a circuit.

3.4 Put the verb into the correct form, past perfect or past simple:

1. Therefore, about 2.5 billion years___________ (to pass) on the earth when life (to originate). 2. The Wright Brothers _______(to launch) their plane at Kitty Hawk before Bell___________ (to develop) his own flying machine. 3. Bell ________ (to patent) his telephone first. 4. Bell__________ (to regard) the photo phone as the greatest invention he____________ (to make). 5. By the end of the XX century a satellite of the planet Pluto____________ (to discover). 6. It_____ (to happen) before they_____________ (to connect) the telephone. 7. When we___________ (to come in) he_____________ (to dial already) the number. 8. The samples ________ to vary) in quality but were generally acceptable. 9. We__________ (to wash) our hands before we___________ (to handle) food. 10. He__________ (to show) the ticket which he__________ (to buy) earlier.

Comprehension Check

3.5 Make up no less than 10 questions to text 1.

3.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Safety monitoring

Safety monitoring is a special case of error detection and recovery in which the malfunction involves a safety hazard. Decisions are required when the automated system sensors detect that a safety condition has developed that would be hazardous to the equipment or humans in the vicinity of the equipment. The purpose of the safety-monitoring system is to detect the hazard and to take the most appropriate action to remove or reduce it. This may involve stopping the operation and alerting maintenance personnel to the condition, or it may involve a more complex set of actions to eliminate the safety problem.

Automated systems are usually required to interact with humans in some way. An automatic bank teller machine, for example, must receive instructions from customers and act accordingly. In some automated systems, a variety of different instructions from humans is possible, and the decision-making capability of the system must be quite sophisticated in order to deal with the array of possibilities.

A fourth reason for decision making in an automated system is to optimize the process. The need for optimization occurs most commonly in processes, in which there is an economic performance criterion whose optimization is desirable. For example, minimizing cost is usually an important objective in manufacturing. The automated system might use adaptive control to receive appropriate sensor signals and other inputs and make decisions to drive the process toward the optimal state.

4 Unit № 4

4.1 Read and translate the text. Use a dictionary to help you.

Industrial robotics

Industrial robotics is an automation technology that has received considerable attention since about 1960. This section will discuss the development of industrial robotics, the design of the robot manipulator, and the methods of programming robots.

Development of robotics

Robotics is based on two related technologies: numerical control and teleoperators. Numerical control (NC) is a method of controlling machine tool axes by means of numbers that have been coded on punched paper tape or other media. It was developed during the late 1940s and early 1950s. The first numerical control machine tool was demonstrated in 1952 in the United States at the Massachusetts Institute of Technology (MIT). Subsequent research at MIT led to the development of the APT (Automatically Programmed Tools) language for programming machine tools.

A teleoperator is a mechanical manipulator that is controlled by a human from a remote location. Initial work on the design of teleoperators can be traced to the handling of radioactive materials in the early 1940s. In a typical implementation, a human moves a mechanical arm and hand at one location, and the manipulator duplicates these motions at another location.

Industrial robotics can be considered a combination of numerical control and teleoperator technologies. Numerical control provides the concept of a programmable industrial machine, and teleoperator technology contributes the notion of a mechanical arm to perform useful work. The first industrial robot was installed in 1961 to unload parts from a die-casting operation. Its development was due largely to the efforts of the Americans George C. Devol, an inventor, and Joseph F. Engelberger, a businessman Devol originated the design for a programmable manipulator, the U.S. patent for which was issued in 1961. Engelberger teamed with Devol to promote the use of robots in industry and to establish the first corporation in robotics—Unimation, Inc.

The robot manipulator

The most widely accepted definition of an industrial robot is one developed by the Robotic Industries Association:

An industrial robot is a reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.

The technology of robotics is concerned with the design of the mechanical manipulator and the computer systems used to control it. It is also concerned with the industrial applications of robots, which are described below.

The mechanical manipulator of an industrial robot is made up of a sequence of link and joint combinations. The links are the rigid members connecting the joints. The joints (also called axes) are the movable components of the robot that cause relative motion between adjacent links. There are five principal types of mechanical joints used to construct the manipulator. Two of the joints are linear, in which the relative motion between adjacent links is translational, and three are rotary types, in which the relative motion involves rotation between links.

The manipulator can be divided into two sections: (1) an arm-and-body, which usually consists of three joints connected by large links, and (2) a wrist, consisting of two or three compact joints. Attached to the wrist is a gripper to grasp a work part or a tool (e.g., a spot-welding gun) to perform a process. The two-manipulator sections have different functions: the arm-and-body is used to move and position parts or tools in the robot's work space, while the wrist is used to orient the parts or tools at the work location. The arm-and-body section of most commercial robots is based on one of four configurations. Each of the anatomies, as they are sometimes called, provides a different work envelope (i.e., the space that can be reached by the robot's arm) and is suited to different types of applications.

Vocabulary

4.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

4.3 Match the words in the left column with their interpretation proposed on the right:

1) Functional organization of a computer	a) processes and stores large amount of data and solves problems of numerical computations;
2) Input	b) circuits used in large-scale digital systems;
3) Memory	c) method of interrelation of the main units of a computer;
4) Control unit	d) removing data from the device to the device to the outside world;
5) Output	e) inserting information into the computer;
6) Arithmetic unit	f) a code of combinations of electric pulses;

7) Machine language	g) performs addition, subtraction, multiplication, etc.;
8) Logic gates	h) stores original data as well as partial results;
9) Digital computer	i) causes all parts of the computer to act as a team.

4.4 Put each verb in brackets into a suitable passive form:

1) I am sorry, madam, but this carpet (already sell) ________. 2) The old house on the corner (knock down) _________ last year. 3) When exactly (John give)_______ his prize? 4) Most people agree that America (not discover) _______ by Christopher Columbus. 5) All complaints about products (deal with) __________ by our customer services department. 6) Police confirmed that the murder weapon (since discover) __________ in a nearby lake. 7) It (announce) ________ yesterday that the government has decided not to raise income tax. 8) Good news! I (ask) _________ to take over as the new manager. 9) I do not believe that this play (write) _________ by Shakespeare. 10) Ann really likes (invite) __________to dinner parties.

Comprehension Check

4.5 Make up no less than 10 questions to text 1.

4.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Robot programming

The computer system that controls the manipulator must be programmed to teach the robot the particular motion sequence and other actions that must be performed in order to accomplish its task. There are several ways that industrial robots are programmed. One method is called lead-through programming. This requires that the manipulator be driven through the various motions needed to perform a given task, recording the motions into the robot's computer memory. This can be done either by physically moving the manipulator through the motion sequence or by using a control box to drive the manipulator through the sequence.

A second method of programming involves the use of a programming language very much like a computer programming language. However, in addition to many of the capabilities of a computer programming language (i.e., data processing, computations, communicating with other computer devices, and decision-making), the robot language also includes statements specifically designed for robot control. These capabilities include (1) motion control and (2) input/output. Motion-control commands are used to direct the robot to move its manipulator to some defined position in space. For example, the statement "move P1" might be used to direct the robot to a point in space called P1. Input/output commands are employed to control the receipt of signals from sensors and other devices in the work cell and to initiate control signals to other pieces of equipment in the cell. For instance, the statement "signal 3, on" might be used to turn on a motor in the cell, where the motor is connected to output line 3 in the robot's controller.

Nevertheless, office automation affects worker-manager relationships in a number of ways. It allows middle-level employees a means of providing company executives with reports of production, costs, and inventory. This removes the dependence on a few subordinates who had traditionally supplied such information. Automation also creates ways to monitor each office worker's efficiency: through computerized information, managers can, for example, count the number of times per hour that a typist strikes a letter on the keyboard. Managers can also ascertain the number, times, and nature of a worker's telephone calls, monitor e-mail, or track the number and nature of Web sites an employee accesses.

5 Unit № 5

5.1 Read and translate the text. Use a dictionary to help you.

Manufacturing applications of automation and robotics

One of the most important application areas for automation technology is manufacturing. To many people, automation means manufacturing automation. In this section, the types of automation are defined, and examples of automated systems used in manufacturing are described.

Three types of automation in production can be distinguished: (1) fixed automation, (2) programmable automation, and (3) flexible automation.

Fixed automation, also known as "hard automation," refers to an automated production facility in which the sequence of processing operations is fixed by the equipment configuration. In effect, the programmed commands are contained in the machines in the form of cams, gears, wiring, and other hardware that is not easily changed over from one product style to another. This form of automation is characterized by high initial investment and high production rates. It is therefore 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. The products are made in batch quantities ranging from several dozen to several thousand units at a time. For each new batch, the production equipment must be reprogrammed and changed over to accommodate the new product style. This reprogramming and changeover take time to accomplish, and there is a period of nonproductive time followed by a production run for each new batch. Production rates in programmable automation are generally lower than in fixed automation, because the equipment is designed to facilitate product changeover rather than for product specialization. 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 computer program controls the machine tool. Industrial robots are another example.

Flexible automation is an extension of programmable automation. The disadvantage with programmable automation is the time required to reprogram and change over the production equipment for each batch of new product. This is lost production time, which is expensive. In flexible automation, the variety of products is sufficiently limited so that the changeover of the equipment can be done very quickly and automatically. The reprogramming of the equipment in flexible automation is done off-line; that is, the programming is accomplished at a computer terminal without using the production equipment itself. Accordingly, there is no need to group identical products into batches; instead, a mixture of different products can be produced one right after another.

Automated production lines

An automated production line consists of a series of workstations connected by a transfer system to move parts between the stations. This is an example of fixed automation, since these lines are typically set up for long production runs, perhaps making millions of product units and running for several years between changeovers. Each station is designed to perform a specific processing operation, so that the part or product is constructed stepwise as it progresses along the line. A raw work part enters at one end of the line, proceeds through each workstation, and emerges at the other end as a completed product. In the normal operation of the line, there is a work part being processed at each station, so that many parts are being processed simultaneously and a finished part is produced with each cycle of the line. The various operations, part transfers, and other activities taking place on an automated transfer line must all be sequenced and coordinated properly for the line to operate efficiently. Modern automated lines are controlled by programmable logic controllers, which are special computers that facilitate connections with industrial equipment (such as automated production lines) and can perform the kinds of timing and sequencing functions required to operate such equipment.

Automated production lines are utilized in many industries, most notably automotive, where they are used for processes such as machining and pressworking. Machining is a manufacturing process in which metal is removed by a cutting or shaping tool, so that the remaining work part is the desired shape. Machinery and motor components are usually made by this process. In many cases, multiple operations are required to completely shape the part. If the part is mass-produced, an automated transfer line is often the most economical method of production. The many separate operations are divided among the workstations. Transfer lines date back to about 1924.

Pressworking operations involve the cutting and forming of parts from sheet metal. Examples of such parts include automobile body panels, outer shells of major appliances (e.g., laundry machines and ranges), and metal furniture (e.g., desks and file cabinets). More than one processing step is often required to complete a complicated part. Several presses are connected together in sequence by handling mechanisms that transfer the partially completed parts from one press to the next, thus creating an automated pressworking line.

Vocabulary

5.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

5.3 Match the words in the left column with their interpretation proposed on the right:

1) Primary	a) one of the performance characteristics of storage measured in binary digits;
2) Secondary	b) memory that has random access to the information
3) Magnetic disc	c) combination if units of information;
4) Binary codes	d) main method of secondary storage performing both sequential and random storage;
5) RAM	e) area of memory where protected programs can be read from but not written on;
6) Bit	f) a fixed number of consecutive bits representing a character;
7) Byte	g) part of memory having lower speed but greater capacity;
8) ROM	h) a unit of information or binary digit;
9) Capacity	i) the most expensive part of memory having the least capacity and the fastest access time.

5.4 Choose the right variant to complete the sentences:

1) The water that has been purified is _______________ (distilled water / distilling water). 2) A device that has been adjusted for errors is a _______________ (calibrating instrument / calibrated instrument). 3) A device that adjusts other instruments is a ________________ (calibrating instrument / calibrated instrument). 4. A bar that attaches one moving part of a machine to another one is a ___________ (connecting rod / connected rod). 5) A wire that is covered with a nonconductor is an _________ (insulated wire / insulating wire). 6) You may choose any _________ (viewing device / viewed device) you like. 7) She is sure to get the job she wants.

She is a very ___________ (determined person / determining person). 8) She was an _________ (inspired example / inspiring example) to her followers.

Comprehension Check

5.5 Make up no less than 10 questions to text 1.

5.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Robots in manufacturing

Today most robots are used in manufacturing operations; the applications can be divided into three categories: (1) material handling, (2) processing operations, and (3) assembly and inspection.

Material-handling applications include material transfer and machine loading and unloading. Material-transfer applications require the robot to move materials or work parts from one location to another. Many of these tasks are relatively simple, requiring robots to pick up parts from one conveyor and place them on another. Other transfer operations are more complex, such as placing parts onto pallets in an arrangement that must be calculated by the robot. Machine loading and unloading operations utilize a robot to load and unload parts at a production machine. This requires the robot to be equipped with a gripper that can grasp parts. Usually the gripper must be designed specifically for the particular part geometry.

In robotic processing operations, the robot manipulates a tool to perform a process on the work part. Examples of such applications include spot welding, continuous arc welding, and spray painting. Spot welding of automobile bodies is one of the most common applications of industrial robots in the United States. The robot positions a spot welder against the automobile panels and frames to complete the assembly of the basic car body. Arc welding is a continuous process in which the robot moves the welding rod along the seam to be welded. Spray painting involves the manipulation of a spray-painting gun over the surface of the object to be coated. Other operations in this category include grinding, polishing, and routing, in which a rotating spindle serves as the robot’s tool.

The third application area of industrial robots is assembly and inspection. The use of robots in assembly is expected to increase because of the high cost of manual labor common in these operations. Since robots are programmable, one strategy in assembly work is to produce multiple product styles in batches, reprogramming the robots between batches. An alternative strategy is to produce a mixture of different product styles in the same assembly cell, requiring each robot in the cell to identify the product style as it arrives and then execute the appropriate task for that unit.

6 Unit № 6

6.1 Read and translate the text. Use a dictionary to help you.

Numerical control

As discussed above, numerical control is a form of programmable automation in which a machine is controlled by numbers (and other symbols) that have been coded on punched paper tape or an alternative storage medium. The initial application of numerical control was in the machine tool industry, to control the position of a cutting tool relative to the work part being machined. The NC part program represents the set of machining instructions for the particular part. The coded numbers in the program specify *x*-*y*-*z* coordinates in a Cartesian axis system, defining the various positions of the cutting tool in relation to the work part. By sequencing these positions in the program, the machine tool is directed to accomplish the machining of the part. A position feedback control system is used in most NC machines to verify that the coded instructions have been correctly performed.

Today a small computer is used as the controller in an NC machine tool, and the program is actuated from computer memory rather than punched paper tape. However, initial entry of the program into computer memory is often still accomplished using punched tape. Since computer implements this form of numerical control, it is called computer numerical control, or CNC. Another variation in the implementation of numerical control involves sending part programs over telecommunications lines from a central computer to individual machine tools in the factory, thus eliminating the use of the punched tape altogether. This form of numerical control is called direct numerical control, or DNC.

Many applications of numerical control have been developed since its initial use to control machine tools. Other machines using numerical control include component-insertion machines used in electronics assembly, drafting machines that prepare engineering drawings, coordinate measuring machines that perform accurate inspections of parts, and flame cutting machines and similar devices. In these applications, the term numerical control is not always used explicitly, but the operating principle is the same: coded numerical data are employed to control the position of a tool or workhead relative to some object.

To illustrate these alternative applications of numerical control, the component-insertion machine will be considered here. Such a machine is used to position electronic components (e.g., semiconductor chip modules) onto a printed circuit board (PCB). It is basically an *x*-*y* positioning table that moves the printed circuit board relative to the part-insertion head, which then places the individual component into position on the board. A typical printed circuit board has dozens of individual components that must be placed on its surface; in many cases, the lead wires of the components must be inserted into small holes in the board, requiring great precision by the insertion machine. The program that controls the machine indicates which components are to be placed on the board and their locations. This information is contained in the product-design database and is typically communicated directly from the computer to the insertion machine.

Assembly operations have traditionally been performed manually, either at single assembly workstations or on assembly lines with multiple stations. Owing to the high labor content and high cost of manual labor, greater attention has been given in recent years to the use of automation for assembly work. Assembly operations can be automated using production line principles if the quantities are large, the product is small, and the design is simple (e.g., mechanical pencils, pens, and cigarette lighters). For products that do not satisfy these conditions, manual assembly is generally required.

Automated assembly machines have been developed that operate in a manner similar to machining transfer lines, with the difference being that assembly operations, instead of machining, are performed at the workstations. A typical assembly machine consists of several stations, each equipped with a supply of components and a mechanism for delivering the components into position for assembly. A workhead at each station performs the actual attachment of the component. Typical workheads include automatic screwdrivers, staking or riveting machines, welding heads, and other joining devices. A new component is added to the partially completed product at each workstation, thus building up the product gradually as it proceeds through the line. Assembly machines of this type are considered to be examples of fixed automation, because they are generally configured for a particular product made in high volume. Programmable assembly machines are represented by the component-insertion machines employed in the electronics industry, as described above.

Vocabulary

6.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

6.3 Match the words in the left column with their interpretation proposed on the right:

1) CPU	a) performs the processing operations;
2) CU	b) carries out logical comparison of storage;
3) ALU	c) executes basic arithmetic functions;
4) Accumulator	d) coordinates the operation of the whole system;
5) Clock	e) selects data from memory;
6) Counter	f) produces electronic marks at regular intervals;
7) Register	g) controls the flow between the primary storage and the arithmetic-logical unit
8) Decoder	h) keeps the instruction while it is being performed;

9) Comparer i) holds the results of processing operations;
10) Adder j) breaks the instructions into separate commands.

6.4 Rewrite each question in indirect speech:
1) "What time does the film start, Peter?" I asked ______________________.
2) "Do you watch television every evening, Chris?" The interviewer asked _________________________.
3) "Why did you apply for the job?" asked the sales manager. The sales manager asked ____________________________________.
4) "Are you taking much money with you to France?" My bank manager wanted to know ___________________________________.
5) "When will I know the results of the examination?" Maria asked the examiner ____ .
6) "Are you enjoying your flight?" The flight attendant asked me __________.
7) "How does the photocopier work?" I asked the salesman ________________.
8) "Have you ever been to Japan, Paul?" Sue asked Paul ________________.

Comprehension Check

6.5 Make up no less than 10 questions to text 1.

6.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Robots in manufacturing

The design of the product is an important aspect of robotic assembly. Assembly methods that are satisfactory for humans are not necessarily suitable for robots. Using a screw and nut as a fastening method, for example, is easily performed in manual assembly, but the same operation is extremely difficult for a one-armed robot. Designs in which the components are to be added from the same direction using snap fits and other one-step fastening procedures enable the work to be accomplished much more easily by automated and robotic assembly methods.

Inspection is another area of factory operations in which the utilization of robots is growing. In a typical inspection job, the robot positions a sensor with respect to the work part and determines whether the part is consistent with the quality specifications.

In nearly all industrial robotic applications, the robot provides a substitute for human labor. There are certain characteristics of industrial jobs performed by humans that identify the work as a potential application for robots: (1) the operation is repetitive, involving the same basic work motions every cycle; (2) the operation is hazardous or uncomfortable for the human worker (*e.g.*,spray painting, spot welding, arc welding, and certain machine loading and unloading tasks); (3) the task requires a work part or tool that is heavy and awkward to handle; and (4) the operation allows the robot to be used on two or three shifts.

Flexible manufacturing systems

A flexible manufacturing system (FMS) is a form of flexible automation in which several machine tools are linked together by a material-handling system, and all aspects of the system are controlled by a central computer. An FMS is distinguished from an automated production line by its ability to process more than one product style simultaneously. At any moment, each machine in the system may be processing a different part type. An FMS can also cope with changes in product mix and production schedule as demand patterns for the different products made on the system change over time. New product styles can be introduced into production with an FMS, so long as they fall within the range of products that the system is designed to process. This kind of system is therefore ideal when demand for the products is low to medium and there are likely to be changes in demand.

The components of an FMS are (1) processing machines, which are usually CNC machine tools that perform machining operations, although other types of automated workstations such as inspection stations are also possible, (2) a material-handling system, such as a conveyor system, which is capable of delivering work parts to any machine in the FMS, and (3) a central computer system that is responsible for communicating NC part programs to each machine and for coordinating the activities of the machines and the material-handling system. In addition, a fourth component of an FMS is human labor. Although the flexible manufacturing system represents a high level of production automation, people are still needed to manage the system, load and unload parts, change tools, and maintain and repair the equipment.

7 Unit № 7

7.1 Read and translate the text. Use a dictionary to help you.

Computer process control

In computer process control, a digital computer is used to direct the operations of a manufacturing process. Although other automated systems are typically controlled by computer, the term computer process control is generally associated with continuous or semi continuous production operations involving materials such as chemicals, petroleum, foods, and certain basic metals. In these operations, the products are typically processed in gas, liquid, or powder form to facilitate flow of the material through the various steps of the production cycle. In addition, these products are usually mass-produced. Because of the ease of handling the product and the large volumes involved, a high level of automation has been accomplished in these industries.

The modern computer process control system generally includes the following: (1) measurement of important process variables such as temperature, flow rate, and pressure, (2) execution of some optimizing strategy, (3) actuation of such devices as valves, switches, and furnaces that enable the process to implement the optimal strategy, and (4) generation of reports to management indicating equipment status, production performance, and product quality. Today computer process control is applied to many industrial operations, two of which are described below.

The typical modern process plant is computer-controlled. In one petrochemical plant that produces more than 20 products, the facility is divided into three areas, each with several chemical-processing units. Each area has its own process-control computer to perform scanning, control, and alarm functions. The computers are connected to a central computer in a hierarchical configuration. The central computer calculates how to obtain maximum yield from each process and generates management reports on process performance.

Each process computer monitors up to 2,000 parameters that are required to control the process, such as temperature, flow rate, pressure, liquid level, and chemical concentration. These measurements are taken on a sampling basis; the time between samples varies between 2 and 120 seconds, depending on the relative need for the data. Each computer controls approximately 400 feedback control loops.

Under normal operation, each control computer maintains operation of its process at or near optimum performance levels. If process parameters exceed the specified normal or safe ranges, the control computer actuates a signal light and alarm horn and prints a message indicating the nature of the problem for the technician. The central computer receives data from the process computers and performs calculations to optimize the performance of each chemical-processing unit. The results of these calculations are then passed to the individual process computers in the form of changes in the set points for the various control loops.

Substantial economic advantages are obtained from this type of computer control in the process industries. The computer hierarchy is capable of integrating all the data from the many individual control loops far better than humans are able to do, thus permitting a higher level of performance. Advanced control algorithms can be applied by the computer to optimize the process. In addition, the computer is capable of sensing process conditions that indicate unsafe or abnormal operation much more quickly than humans can. All these improvements increase productivity, efficiency, and safety during process operation.

Like the chemical-processing industries, the basic metals industries (iron and steel, aluminum, etc.) have automated many of their processes by computer control. Like the chemical industries, the metals industries deal in large volumes of products, and so there is a substantial economic incentive to invest in automation.

However, metals are typically produced in batches rather than continuously, and it is generally more difficult to handle metals in bulk form than chemicals that flow.

An example of computer process control in the metals industry is the rolling of hot metal ingots into final shapes such as coils and strips. This was first done in the steel industry, but similar processing is also accomplished with aluminum and other metals. In a modern steel plant, hot rolling is performed under computer control. The rolling process involves the forming of a large, hot metal billet by passing it through a rolling mill consisting of one or more sets of large cylindrical rolls that squeeze the metal and reduce its cross section. Several passes are required to reduce the ingot gradually to the desired thickness. Sensors and automatic instruments measure the dimensions and temperature of the ingot after each pass through the rolls, and the control computer calculates and regulates the roll settings for the next pass.

In a large plant, several orders for rolled products with different specifications may be in the mill at any given time. Control programs have been developed to schedule the sequence and rate at which the hot metal ingots are fed through the rolling mills. The production control task of scheduling and keeping track of the different orders requires rapid, massive data gathering and analysis. In modern plants this task has been effectively integrated with the computer control of the rolling mill operations to achieve a highly automated production system.

Vocabulary

7.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

7.3 Match the words in the left column with their interpretation proposed on the right:

1) Computer literacy	a) the set of instructions that direct the operations of computers;
2) Computer	b) a part of a computer, entering data into the device;
3) Program	c) facts unorganized but able to be organized;
4) Data	d) output of a data processing system;
5) Data processing	e) possessing sufficient knowledge of how computers work and what they can do to use them as problem-solving tools;
6) Data processing system	f) a series of operations that results in the conversation of data system into useful information;
7) Input	g) electronic device performing calculations on numerical data;

8) Output	h) electronic device accepting the data processing results from the computer and displaying them;
9) Useful information	i) set of related files;
10) Data bank	j) resources required to accomplish the processing of data. These resources are personnel, material, facilities and equipment.

7.4 Rewrite each sentence as direct speech:

1) Graham told Ian he would see him the following day. Graham said, "_____________"

2) Pauline told the children their swimming things were not there. "___________": said Pauline.

3) David told me my letter had arrived the day before. "______________", said David.

4) Shirley told Larry she would see him that evening. " _____________", said Shirley.

5) Bill told Stephen he hadn't been at home that morning. " ____________", said Bill.

6) Margaret told John to phone her on the following day. "_______________", said Margaret.

7) Tim told Ron he was leaving that afternoon. "_________________", said Tim.

8) Christine told Michael she had lost her lighter the night before. "______________", said Christine.

Comprehension Check

7.5 Make up no less than 10 questions to text 1.

7.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Computer-integrated manufacturing

Since about 1970 there has been a growing trend in manufacturing firms toward the use of computers to perform many of the functions related to design and production. The technology associated with this trend is called CAD/CAM, for computer-aided design and computer-aided manufacturing. Today it is widely recognized that the scope of computer applications must extend beyond design and production to include the business functions of the firm. The name given to this more comprehensive use of computers is computer-integrated manufacturing (CIM).

CAD/CAM is based on the capability of a computer system to process, store, and display large amounts of data representing part and product specifications. For mechanical products, the data represent graphic models of the components; for electrical products, they represent circuit information; and so forth. CAD/CAM technology has been applied in many industries, including machined components, electronics products, and equipment design and fabrication for chemical processing. CAD/CAM involves not only the automation of the manufacturing operations but also the automation of elements in the entire design-and-manufacturing procedure.

Computer-aided design (CAD) makes use of computer systems to assist in the creation, modification, analysis, and optimization of a design. The designer, working with the CAD system rather than the traditional drafting board, creates the lines and surfaces that form the object (product, part, structure, etc.) and stores this model in the computer database. By invoking the appropriate CAD software, the designer can perform various analyses on the object, such as heat transfer calculations. The final object design is developed as adjustments are made on the basis of these analyses. Once the design procedure has been completed, the computer-aided design system can generate the detailed drawings required to make the object.

Computer-aided manufacturing (CAM) involves the use of computer systems to assist in the planning, control, and management of production operations. This is accomplished by either direct or indirect connections between the computer and production operations. In the case of the direct connection, the computer is used to monitor or control the processes in the factory. Computer process monitoring involves the collection of data from the factory, the analysis of the data, and the communication of process-performance results to plant management. These measures increase the efficiency of plant operations.

Computer process control entails the use of the computer system to execute control actions to operate the plant automatically, as described above. Indirect connections between the computer system and the process involve applications in which the computer supports the production operations without actually monitoring or controlling them. These applications include planning and management functions that can be performed by the computer (or by humans working with the computer) more efficiently than by humans alone. Examples of these functions are planning the step-by-step processes for the product, part programming in numerical control, and scheduling the production operations in the factory.

Computer-integrated manufacturing includes all the engineering functions of CAD/CAM and the business functions of the firm as well. These business functions include order entry, cost accounting, employee time records and payroll, and customer billing. In an ideal CIM system, computer technology is applied to all the operational and information-processing functions of the company, from customer orders through design and production (CAD/CAM) to product shipment and customer service. The scope of the computer system includes all activities that are concerned with manufacturing. In many ways, CIM represents the highest level of automation in manufacturing.

8 Unit № 8

8.1 Read and translate the text. Use a dictionary to help you.

Automation in daily life

In addition to the manufacturing applications of automation technology, there have been significant achievements in such areas as communications, transportation, service industries, and consumer products.

Communications. One of the earliest practical applications of automation was in telephone switching. The first switching machines, invented near the end of the 19th century, were simple mechanical switches that were remotely controlled by the telephone user pushing buttons or turning a dial on the phone.

Modern electronic telephone switching systems are based on highly sophisticated digital computers that perform functions such as monitoring thousands of telephone lines. They determine which lines require service, storing the digits of each telephone number as it is being dialed, setting up the required connections, sending electrical signals to ring the receiver's phone, monitoring the call during its progress, and disconnecting the phone when the call is completed.

These systems also are used to time and bill toll calls and to transmit billing information and other data relative to the business operations of the phone company. In addition to the various functions mentioned, the newest electronic systems automatically transfer calls to alternate numbers, call back the user when busy lines become free, and perform other customer services in response to dialed codes. These systems also perform function tests on their own operations, diagnose problems when they arise, and print out detailed instructions for repairs.

Other applications of automation in communications systems include local area networks, communications satellites, and automated mail-sorting machines. A local area network (LAN) operates like an automated telephone company within a single building or group of buildings. Local area networks are generally capable of transmitting not only voice but also digital data between terminals in the system. Communications satellites have become essential for communicating telephone or video signals across great distances. Such communications would not be possible without the automated guidance systems that place and retain the satellites in predetermined orbits. Automatic mail-sorting machines have been developed for use in many post offices throughout the world to read codes on envelopes and sort the envelopes according to destination.

Transportation. Automation has been applied in various ways in the transportation industries. Applications include airline reservation systems, automatic pilots in aircraft and locomotives, and urban mass-transit systems. The airlines use computerized reservation systems to monitor continuously the status of all flights. With these systems, ticket agents at widely dispersed locations can obtain information about the availability of seats on any flight in a matter of seconds. The reservation systems compare requests for space with the status of each flight, grant space when available, and automatically update the reservation status files. Passengers can even receive their seat assignments well in advance of flight departures.

Nearly all commercial aircrafts are equipped with instruments called automatic pilots. Under normal flying conditions, these systems guide an airplane over a predetermined route by detecting changes in the aircraft's orientation and heading from gyroscopes and similar instruments and by providing appropriate control signals to the plane's steering mechanism. Automatic navigation systems and instrument landing systems operate by using radio signals from ground beacons that provide the aircraft with course directions for guidance. When an airplane is within the traffic pattern for ground control, its human pilot normally assumes control.

Service industries. Automation of service industries includes an assortment of applications as diverse as the services themselves, which include health care, banking, and other financial services, government, and retail trade.

In health care, the use of automation in the form of computer systems has increased dramatically to improve services and relieve the burden on medical staffs. In hospitals, computer terminals on each nursing care floor record data on patient status, medications administered, and other relevant information. Some of these systems are used to perform additional functions such as ordering drugs from the hospital pharmacy and calling for orderlies. The system provides an official record of the nursing care given to patients and is used by the nursing staff to give a report at shift-change time. The computer system is connected to the hospital's business office so that proper charges can be made to each patient's account for services rendered and medicines provided.

Robotics is likely to play a role in future health care delivery systems. The work that is done in hospitals by nurses, orderlies, and similar staff personnel includes some tasks that are routine and repetitive. Duties that might be automated using robots include making beds, delivering linens, and moving supplies between locations in the hospital.

Robots might even become involved in certain aspects of patient care such as transporting patients to services in the hospital, passing food trays, and similar functions in which it is not critical that a hospital staff member be present. Research is currently under way to develop robots that would be capable of assisting to paraplegics and other physically handicapped persons. These robots would respond to voice commands and would be able to interpret statements in natural language (e.g., everyday English) from patients requesting service.

Vocabulary

8.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

8.3 Find in the right column words that are opposite in meaning to the words in the left column:

1) Urban	a) central, b) rural, c) internal, d) major;
2) Diverse	a) different, b) various, c) uniform, d) numerous;
3) Currently	a) previously, b) usually, c) probably, d) gradually;
4) Small	a) valuable, b) rapid, c) tremendous, d) full;
5) To respond	a) to answer, b) to request, c) to ask, d) to command;
6) To improve	a) to worsen, b) to order, c) to demand d) to load;
7) Similar	a) close, b) different, c) recent, d) important;
8) Simple	a) successful, b) complicated, c) reliable, d) considerable;
9) Additional	a) mean, b) efficient, c) main, d) narrow;
10) After	a) without, b) in order to, c) while, d) before;

8.4 Put each verb in brackets into a suitable verb form:

1) Why didn't you phone? If I (know)___________you were coming, I (meet) ___________you at the airport.

2) It's a pity you missed the party. If you (come)_____,you (meet) ________ my friend from Hungary.

3) If we (have)_____________ some tools, we (be able)____________to repair the car, but we haven't got any with us.

4) If you (not help) ______me, I (not pass) __________the exam.

5) It's a beautiful house, I (buy) ___________ it if I (have) _________the money, but I can't effort it.

6) I can't imagine what I (do) ______________ with the money if I (win) ______ the lottery.

7) If Marc (train) _______ harder, he (be) ____________a good runner.

8) If Claire (listen) _________________to her mother, she (not marry) ______________David in the first place.

Comprehension Check

8.5 Make up no less than 10 questions to text 1.

8.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Advantages and disadvantages of automation

Advantages commonly attributed to automation include higher production rates and increased productivity, more efficient use of materials, better product quality, improved safety, shorter workweeks for labor, and reduced factory lead times. Higher output and increased productivity have been two of the biggest reasons in justifying the use of automation. Despite the claims of high quality from good workmanship by humans, automated systems typically perform the manufacturing process with less variability than human workers, resulting in greater control and consistency of product quality. In addition, increased process control makes more efficient use of materials, resulting in less scrap.

Worker safety is an important reason for automating an industrial operation. Automated systems often remove workers from the workplace, thus safeguarding them against the hazards of the factory environment. In the United States the Occupational Safety and Health Act of 1970 (OSHA) was enacted with the national objective of making work safer and protecting the physical well-being of the worker. OSHA has had the effect of promoting the use of automation and robotics in the factory.

Another benefit of automation is the reduction in the number of hours worked on average per week by factory workers. About 1900 the average workweek was approximately 70 hours. This has gradually been reduced to a standard workweek in the United States of about 40 hours. Mechanization and automation have played a significant role in this reduction. Finally, the time required to process a typical production order through the factory is generally reduced with automation.

A main disadvantage often associated with automation, worker displacement, has been discussed above. Despite the social benefits that might result from retraining displaced workers for other jobs, in almost all cases the worker whose job has been taken over by a machine undergoes a period of emotional stress. In addition to displacement from work, the worker may be displaced geographically. In order to find other work, an individual may have to relocate, which is another source of stress.

Other disadvantages of automated equipment include the high capital expenditure required to invest in automation (an automated system can cost millions of dollars to design, fabricate, and install), a higher level of maintenance needed than with a manually operated machine, and a generally lower degree of flexibility in terms of the possible products as compared with a manual system (even flexible automation is less flexible than humans, the most versatile machines of all).

In addition, there are potential risks that automation technology will ultimately subjugate rather than serve humankind. The risks include the possibility that workers will become slaves to automated machines, that the privacy of humans will be invaded by vast computer data networks, that human error in the management of technology will somehow endanger civilization, and that society will become dependent on automation for its economic well-being.

These dangers aside, automation technology, if used wisely and effectively, can yield substantial opportunities for the future. There is an opportunity to relieve humans from repetitive, hazardous, and unpleasant labor in all forms. Moreover, there is an opportunity for future automation technologies to provide a growing social and economic environment in which humans can enjoy a higher standard of living and a better way of life.

9 Unit № 9

9.1 Read and translate the text. Use a dictionary to help you.

Automation and society

Over the years, labor leaders, business executives, government officials, and college professors have argued the social merits of automation. The biggest controversy has focused on how automation affects employment. There are other important aspects of automation, including its effect on productivity, economic competition, education, and quality of life.

Impact on the individual. Nearly all industrial installations of automation, and in particular robotics, involve a replacement of human labor by an automated system. Therefore, one of the direct effects of automation in factory operations is the dislocation of human labor from the workplace. The long-term effects of automation on employment and unemployment rates are debatable. Most studies in this area have been controversial and inconclusive.

Workers have indeed lost jobs through automation, but population increases and consumer demand for the products of automation have compensated for these losses. Labor unions have argued, and many companies have adopted the policy, that workers displaced by automation should be retrained for other positions, perhaps increasing their skill levels in the process. This argument succeeds so long as the company and the economy in general are growing at a rate fast enough to create new positions as the jobs replaced by automation are lost.

Of particular concern for many labor specialists is the impact of industrial robots on the work force, since robot installations involve a direct substitution of machines for humans, sometimes at a ratio of two to three humans per robot. The opposing argument within the United States is that robots can increase productivity in American factories, thereby making these firms more competitive and ensuring that jobs are not lost to overseas companies. The effect of robotics on labor has been relatively minor, because the number of robots in the United States is small compared with the number of human workers. As of the early 1990s, there were fewer than 100,000 robots installed in American factories, compared with a total work force of more than 100 million persons, about 20 million of whom work in factories.

Automation affects not only the number of workers in factories but also the type of work that is done. The automated factory is oriented toward the use of computer systems and sophisticated programmable machines rather than manual labor. Greater emphasis is placed on knowledge-based work and technical skill rather than physical work. The types of jobs found in modern factories include more machine maintenance, improved scheduling and process optimization, systems analysis, and computer programming and operation. Consequently, workers in automated facilities must be technologically proficient to perform these jobs.

Professional and semiprofessional positions, as well as traditional labor jobs, are affected by this shift in emphasis toward factory automation.

Impact on society. Besides affecting individual workers, automation has an impact on society in general. Productivity is a fundamental economic issue that is influenced by automation. The productivity of a process is traditionally defined as the ratio of output units to the units of labor input. A properly justified automation project will increase productivity owing to increases in production rate and reductions in labor content. Over the years, productivity gains have led to reduced prices for products and increased prosperity for society.

A number of issues related to education and training have been raised by the increased use of automation, robotics, computer systems, and related technologies. As automation has increased, there has developed a shortage of technically trained personnel to implement these technologies competently. This shortage has had a direct influence on the rate at which automated systems can be introduced. The shortage of skilled staffing in automation technologies raises the need for vocational and technical training to develop the required work-force skills. Unfortunately, the educational system is also in need of technically qualified instructors to teach these subjects, and the laboratory equipment available in schools does not always represent the state-of-the-art technology typically used in industry.

Vocabulary

9.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

9.3 Find in text 1 the words that are close in meaning to the following ones:

Verbs: to fulfill; to influence; to concentrate; to contain; to determine; to increase.

Nouns: replacement; effect; plant; displacement; lack; occupation.

Adjectives: main; conventional; special; complex; questionable; decreased.

9.4 Underline the most suitable future form:

1) Why *are you going to buy/ will you buy* a new mountain bike?
2) Don't phone between 8.00 and 9.00. *I will study/ I will be studying* then.
3) Look out! That tree *will/is going to* fall!
4) Let me know as soon as Louise *will get/gets* there.
5) Great news! Jean and Chris *will come/are coming* to stay with us.
6) According to this timetable, the bus *is going to arrive/arrives* at 6.00.
7) Can you call me at 7.00, because *I will leave/I am leaving* tomorrow?
8) If you arrive late at the sale, the best things *will go/will have gone*.

Comprehension Check

9.5 Make up no less than 10 questions to text 1.

9.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Microcontrollers

A microcontroller (or *MCU* for microcontroller unit) is a small computer on a single integrated circuit. In modern terminology, it is similar to, but less sophisticated than, a system on a chip or SoC; an SoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general-purpose applications consisting of various discrete chips.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

Some microcontrollers may use four-bit words and operate at frequencies as low as 4 kHz, for low power consumption (single-digit milliwatts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

Microcontrollers must provide real-time (predictable, though not necessarily fast) response to events in the embedded system they are controlling. When certain events occur, an interrupt system can signal the processor to suspend processing the current instruction sequence and to begin an interrupt service routine (ISR, or "interrupt handler") which will perform any processing required based on the source of the interrupt, before returning to the original instruction sequence. Possible interrupt sources are device dependent, and often include events such as an internal timer overflow, completing an analog to digital conversion, a logic level change on an input such as from a button being pressed, and data received on a communication link. Where power consumption is important as in battery devices, interrupts may also wake a microcontroller from a low-power sleep state where the processor is halted until required to do something by a peripheral event.

10 Unit № 10

10.1 Read and translate the text. Use a dictionary to help you.

Programs

Typically, micro-controller programs must fit in the available on-chip memory, since it would be costly to provide a system with external, expandable memory. Compilers and assemblers are used to convert both high-level and assembly language codes into a compact machine code for storage in the micro-controller's memory. Depending on the device, the program memory may be permanent, read-only memory that can only be programmed at the factory, or it may be field-alterable flash or erasable read-only memory.

Manufacturers have often produced special versions of their micro-controllers in order to help the hardware and software development of the target system. Originally, these included EPROM versions that have a "window" on the top of the device through which program memory can be erased by ultraviolet light, ready for reprogramming after a programming ("burn") and test cycle. Since 1998, EPROM versions are rare and have been replaced by EEPROM and flash, which are easier to use (can be erased electronically) and cheaper to manufacture.

Other versions may be available where the ROM is accessed as an external device rather than as internal memory, however these are becoming rare due to the widespread availability of cheap microcontroller programmers.

The use of field-programmable devices on a micro controller may allow field update of the firmware or permit late factory revisions to products that have been assembled but not shipped. Programmable memory also reduces the lead-time required for deployment of a new product.

Where hundreds of thousands of identical devices are required, using parts programmed at the time of manufacture can be economical. These "mask programmed" parts have the program laid down in the same way as the logic of the chip, at the same time.

A customized micro-controller incorporates a block of digital logic that can be personalized for additional processing capability, peripherals and interfaces that are adapted to the requirements of the application. One example is the AT91CAP from Atmel.

Other microcontroller features

Microcontrollers usually contain from several to dozens of general-purpose input/output pins (GPIO). GPIO pins are software configurable to either an input or an output state. When GPIO pins are configured to an input state, they are often used to read sensors or external signals. Configured to the output state, GPIO pins can drive external devices such as LEDs or motors, often indirectly, through external power electronics.

Many embedded systems need to read sensors that produce analog signals. This is the purpose of the analog-to-digital converter (ADC). Since processors are built to interpret and process digital data, i.e. 1s and 0s, they are not able to do anything with the analog signals that may be sent to it by a device. So the analog to digital converter is used to convert the incoming data into a form that the processor can recognize. A less common feature on some microcontrollers is a digital-to-analog converter (DAC) that allows the processor to output analog signals or voltage levels.

In addition to the converters, many embedded microprocessors include a variety of timers as well. One of the most common types of timers is the Programmable Interval Timer (PIT). A PIT may count down from some value either to zero, or up to the capacity of the count register, overflowing to zero. Once it reaches zero, it sends an interrupt to the processor indicating that it has finished counting. This is useful for devices such as thermostats, which periodically test the temperature around them to see if they need to turn the air conditioner on, the heater on, etc.

A dedicated Pulse Width Modulation (PWM) block makes it possible for the CPU to control power converters, resistive loads, motors, etc., without using many CPU resources in tight timer loops.

A Universal Asynchronous Receiver/Transmitter (UART) block makes it possible to receive and transmit data over a serial line with very little load on the CPU. Dedicated on-chip hardware also often includes capabilities to communicate with other devices (chips) in digital formats such as Inter-Integrated Circuit (I^2C), Serial Peripheral Interface (SPI), Universal Serial Bus (USB), and Ethernet.

Vocabulary

10.2 Complete the vocabulary (term) log, i.e. find out definition, part of speech, translation, synonyms and antonyms if possible, decode abbreviations.

Lexis and Grammar

10.3 Match the words that have a similar meaning:

1) Program	a) usually
2) To reduce	b) application
3) Additional	c) to decrease
4) Typically	d) converter
5) To convert	e) feature
6) Manufacturer	f) software
7) Use	g) to turn

8) Transducer — h) to achieve
9) Capability — i) producer
10) To reach — j) supplementary

8) Transducer	h) to achieve
9) Capability	i) producer
10) To reach	j) supplementary

10.4 Put each verb in brackets into a suitable verb form:

1) Why didn't you phone? If I (know)__________you were coming, I (meet) __________you at the airport.

2) It's a pity you missed the party. If you (come)_____, you (meet) ________ my friend from Hungary.

3) If we (have)____________ some tools, we (be able)___________to repair the car, but we haven't got any with us.

4) If you (not help) ______me, I (not pass) _________the exam.

5) It's a beautiful house, I (buy) __________ it if I (have) _________the money, but I can't effort it.

6) I can't imagine what I (do) _____________ with the money if I (win) ______ the lottery.

7) If Marc (train) _______ harder, he (be) ___________a good runner.

8) If Claire (listen) ________________to her mother, she (not marry) _____________David in the first place.

Comprehension Check

10.5 Make up no less than 10 questions to text 1.

10.6 Read the following text and write a summary to it (no less than 7 sentences) in Russian and English.

Text 2

Programming environments

Microcontrollers were originally programmed only in assembly language, but various high-level programming languages, such as C, Python and JavaScript, are now also in common use to target microcontrollers and embedded systems. These languages are designed either especially for the purpose, or for versions of general-purpose languages such as the C programming language. Compilers for general-purpose languages will typically have some restrictions as well as enhancements to better support the unique characteristics of microcontrollers. Some microcontrollers have environments to aid developing certain types of applications. Microcontroller vendors often make tools freely available to make it easier to adopt their hardware.
Many microcontrollers are so quirky that they effectively require their own non-standard dialects of C, such as SDCC for the 8051, which prevent using standard tools (such as code libraries or static analysis tools) even for code unrelated to hardware features. Interpreters are often used to hide such low level quirks.

Interpreter firmware is also available for some microcontrollers. For example, BASIC on the early microcontrollers Intel 8052; BASIC and FORTH on the Zilog Z8 as well as some modern devices. Typically, these interpreters support interactive programming.

Simulators are available for some microcontrollers. These allow a developer to analyze what the behavior of the microcontroller and their program should be if they were using the actual part. A simulator will show the internal processor state and that of the outputs, as well as allowing input signals to be generated. While on the one hand, most simulators will be limited from being unable to simulate much other hardware in a system, they can exercise conditions that may otherwise be hard to reproduce at will in the physical implementation, and can be the quickest way to debug and analyze problems.

Recent microcontrollers are often integrated with on-chip debug circuitry that when accessed by an in-circuit emulator (ICE) via JTAG, allow debugging of the firmware with a debugger. A real-time ICE may allow viewing and/or manipulating of internal states while running. A tracing ICE can record executed program and MCU states before/after a trigger point.

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