Министерство науки и высшего образования РФ
ФГБОУВО «Заполярный государственный университет им. Н.М. Федоровского»
Кафедра философии, истории и иностранных языков

ЧТЕНИЕ ТЕХНИЧЕСКИХ ТЕКСТОВ ПО СПЕЦИАЛЬНОСТИ

Методические указания
к самостоятельной работе

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Методические указания соответствуют Федеральному государственному образовательному стандарту и требованиям программы по английскому языку для неязыковых вузов.

Помогают развивать у студентов умения и навыки читать литературу по специальности, извлекать из неё необходимую информацию и использовать её при подготовке сообщений. Текстовый материал подобран из оригинальных английских и американских источников. Особое внимание уделяется частотности употребления профессиональных терминологических единиц.

Предназначены для аудиторной и внеаудиторной работы студентов-бакалавров второго курса по направлениям подготовки «Электроэнергетика и электротехника» и «Автоматизация технологических процессов и производств» всех форм обучения.

Могут быть использованы для работы на факультативных занятиях, а также для работы с аспирантами.

ВВЕДЕНИЕ

Методические указания по дисциплине «Английский язык» предназначены для практических аудиторных занятий, а также для внеаудиторной самостоятельной работы студентов-бакалавров второго курса по направлениям подготовки, связанным с электроэнергетикой и автоматизацией.

Основная цель – совершенствование умений и навыков читать оригинальную литературу по специальности, извлекая необходимую информацию по профессиональной тематике, делать сообщения и вести беседу на основе изученного материала.

Методические указания состоят из 13 разделов (Units), имеющих аналогичную структуру: текст и блок упражнений, направленных на закрепление активной лексики, включающей наиболее употребительные для данной специальности термины, а также синтаксические структуры, типичные для современной научно-технической литературы. Тексты расположены в логической последовательности с учётом преемственности слов и выражений, а также их многократной повторяемости. Словарный запас, формируемый на этой основе, служит достижению главной учебной цели – развитию умений устного общения с учётом профессиональной направленности.

Для обеспечения более эффективного практического владения английским языком большое внимание уделяется повторению грамматического материла. Упражнения построены на лексике текстов, что позволяет лучше запоминать терминологию. Упражнения дискуссионного характера способствуют совершенствованию навыков устной речи, а упражнения на общее или точное понимание текста помогают усвоить фразеологические обороты, которые характеризуют язык научной прозы.

Текстовые материалы, составляющие данные методические указания, отобраны из оригинальной литературы и электронных ресурсов, связанных с подготовкой бакалавров по вышеупомянутым направлениям.

UNIT 1

Read and translate the text.

ENGINEERING

Engineering is the design, analysis, and/or construction of works for practical purposes. The history of the concept of "engineering" stems from the earliest times when humans began to make clever inventions, such as the pulley, lever, or wheel, etc. The exact etymology of the word engineer, however, is a person occupationally connected with the study, design, and implementation of engines. The word "engine" means "innate quality, especially mental power, hence a clever invention". Thus, an engineer, essentially, is someone who makes useful or practical inventions. From another perspective, a now obsolete meaning of engineer is "a constructor of military engines". Engineering was originally divided into military engineering, which included construction of fortifications as well as military engines, and civil engineering, non-military construction of such as bridges.

With the rise of engineering as a profession in the nineteenth century the term became more narrowly applied to fields in which mathematics and science were applied to these ends. Similarly, in addition to military and civil engineering the fields then known as the mechanic arts became incorporated into engineering. Now the broad discipline of engineering encompasses a range of specialized subdisciplines.

Engineering is a subject that ranges from large collaborations to small individual projects. Almost all engineering projects are beholden to some sort of financing agency: a company, a set of investors, or a government. The few types of engineering that are minimally constrained by such issues are pro bono engineering and open design engineering.

By its very nature engineering is bound up with society and human behaviour. Every product or construction used by modern society will have been influenced by engineering design. Engineering design is a very powerful tool to make changes to environment, society and economics, and its application brings with it a great responsibility.

Words to be remembered:

pulley – (n,v) блок; шкив	**beholden** – (adj) обязанный; признательный (to, for)
lever – (n) рычаг; балансир; рукоятка	**constrain** – (v) стеснять; сдерживать
implementation – (n) осуществление; выполнение; изготовление	**bound up** – (v) связанный (with something, with somebody)
innate – (adj) врождённый; природный	**influence** – (v) оказывать влияние, воздействие; влиять
obsolete – (adj) устаревший	**pro bono** – (от лат. *pro bono publica* – ради общественного блага) – оказание профессиональной помощи благотворительным, общественным и иным некоммерческим организациям, а также частным лицам, которые не могут оплатить подобную помощь
encompass – (v) заключать; включать (в себя)	
range – (n,v) предел; диапазон; сфера; простираться	
collaboration – (n) совместная работа, сотрудничество; разработка	

Exercise 1. Find English equivalents in the text:

1) для практических целей (применения);
2) связанный с изучением, проектированием и созданием;
3) врождённое качество (свойство);
4) полезные и практичные, целесообразные изобретения;
5) крупные разработки;
6) связаны с финансирующими организациями;
7) изменять окружающую среду, общество и экономику.

Exercise 2. Look through the text again and find out whether these statements are true or false.

1. There were originally two branches of engineering.
2. The concept of "engineering" is a modern one.
3. The mechanic arts became incorporated into engineering in the 19th century.
4. Engineering originally included only construction of bridges.
5. Only investors finance engineering projects.
6. There are many specialized subdisciplines in engineering.
7. Application of engineering design brings with it great responsibility.

Exercise 3. Answer the following questions. If you can't, use the text.

1. What is engineering?
2. What is the history of the concept of «engineering»?
3. What is the exact etymology of the word «engineer»?
4. How many trends was engineering originally divided into?
5. What did military engineering deal with?
6. What did civil engineering deal with?
7. Which new branch of engineering appeared in the 19th century?
8. What kinds of agencies finance engineering projects?
9. Engineering design is a very powerful tool to make changes to environment, society and economies, isn't it?

Exercise 4. Explain in your own words the meaning of the following terms:

1) military engineering;
2) civil engineering;
3) mechanical engineering;
4) specialized subdisciplines;
5) financing agencies;
6) individual project.

Exercise 5. Look through the text again and tell about the stages of the engineering development. You may make up a plan of your story (in writing).

Exercise 6. Please discuss with your groupmates advantages and disadvantages of the engineering profession. Is it prestigious? Well-paid?

Exercise 7. Memorize the following words and word combinations. Add them to your active vocabulary:

1) well-paid job – высокооплачиваемая работа;
2) employee – наёмный рабочий;
3) employer – наймодатель, работодатель;
4) state-employed – государственный служащий;
5) white-collar worker – «белый воротничок», работник умственного труда;
6) blue-collar worker – «синий воротничок», работник физического труда;
7) skilled worker – квалифицированный рабочий;

8) experienced worker – опытный рабочий;
9) to be fired – быть уволенным.

Exercise 8. How do you see your future profession? Discuss with your groupmates the work you are interested in:

1) well-paid and interesting;
2) prestigious;
3) to manage people;
4) to be a state employee;
5) in a large and famous company;
6) in an industry which has a future;
7) not to sit the whole day in the office;
8) self-employed, businessman;
9) to be a top manager, director;
10) to be an experienced specialist.

Exercise 9. Tell a story about your future profession. Use the above text.

UNIT 2

Read and translate the text.

COMPUTER ENGINEERING

Computer industry is developing so fast, that it comprises almost all spheres of professional life. No business now is possible without computers. This is especially true about automated manufacturing of products and robotics. Computer control of automated production opens new horizons for the cheap and quality production of goods. Information is now generated, transmitted, received, and stored electronically through computer networks on a scale unprecedented in history, and there is every indication that the explosive rate of growth in this field will continue.

Computer engineering is a general field. It deals with both electric and electronic industries. Electronic engineering deals with the research, design, integration, and application of circuits and devices used in the transmission and processing of information.

Engineers in the field of electric and electronic engineering are concerned with all aspects of electrical communications, from fundamental questions such as «What is information?» to the highly practical, such as the design of telephone systems. In designing communication systems, engineers rely on various branches of advanced mathematics, such as Fourier analysis, linear systems theory, linear algebra, differential equations, and probability theory. Engineers work on control systems which are used extensively in automated manufacturing and in robotics.

Major developments in the field of communications and control have been the replacement of analogue systems with digital systems; fibre optics is used now instead of copper cables. Digital systems offer far greater immunity to electrical noise. Fibre optics is likewise immune to interference; it also has great carrying capacity, and is extremely light and inexpensive to manufacture.

Computer engineering is now the most rapidly growing field. The electronics of computers is the design and manufacture of memory systems, of central processing units, and

of peripheral devices. The most prospective industry now is the Very Large Scale Integration (VLSI) and new computer architectures.

Words to be remembered:

comprise – (v) охватывать; содержать; заключать в себе	**replacement** – (n) замена; замещение
indication –(n) показание; знак	**fibre** – (n) волокно; ткань
scale – (n) масштаб; шкала	**immunity** – (n) невосприимчивость
deal – (r) иметь дело; общаться	**interference** – (n) препятствие; помеха; вмешательство
rely – (r) полагаться; доверять; быть уверенным (on, upon)	

Exercise 10. Find English equivalents in the text:

1) автоматизированное производство продуктов;
2) дешёвые и качественные товары;
3) хранить информацию;
4) передача и обработка информации;
5) замена аналоговых систем на цифровые;
6) невосприимчивость к шуму;
7) быстрорастущая отрасль;
8) самая перспективная область производства;
9) проектирование и производство систем.

Exercise 11. Translate the following sentences.

1. Software is the term used to describe the instructions that tell the hardware how to perform a task.

2. Without software instructions the hardware doesn't know what to do.

3. The basic job of the computer is the processing of information.

4. Computers accept information in the form of instruction called a program and characters (символы) called data to perform mathematical and logical operations, and then give the results.

5. The data is raw material while information is organized, processed, refined and useful for decision making.

6. Computer is used to convert data into information.

7. Computer is also used do store information in the digital form.

Exercise 12. Match the following:

1)… doesn't come to life until it is a) program;

connected to other parts of a system;

2) … is the most important component because it is made by people;	b) information;
3) … create the computer software instructions and respond do the procedures that those instructions present;	c) memory;
4) Information in the form of instruction is called…;	d) software;
5) The manner in which the various individual systems are connected is…;	e) connectivity;
6) …is organized, processed and useful for decision making;	f) computer;
7) The more … you have in your computer, the more operations you can perform;	g) people.

Exercise 13. Answer the following questions.

1. What does computer engineering deal with?
2. Where is computer control used?
3. What do engineers rely on in designing communication systems?
4. Analogue systems and digital systems. Which of them are more effective?
5. What is used instead of copper cables?
6. What do you know about fibre optics?

Exercise 14. Read the following sentences and make up questions to the underlined words.

1. Among various recent trends in the engineering profession computerization is the most wide spread.
2. The trend in modern engineering offices is also towards computerization.
3. Computers are increasingly used for solving complex problems as well as for handling, storing and generating the enormous volume of data.

Exercise 15. Complete the following sentences. Choose the appropriate words from the list below:

1. The unit of electrical resistance is…;	a) a circuit;
2. The unit of electrical pressure (electro-motive force) is…;	b) a conductor;
3. Electric charges that are not flowing are…;	c) an electric current;

4. Current which flows back and forth in a circuit constantly, rapidly changing its direction is…; d) an alternating current;

5. Flow of electrons along a conductor is…; e) static electricity;

6. Any substance that easily carries an electric current is…; f) transistors;

7. The complete path through which the current flows is…; g) a direct current;

8. A device used for detecting planes, ships and other objects is…; h) an ohm;

9. Current which flows through a circuit in one direction only is…; i) a volt;

10. Small-sized instruments for replacing vacuum tubes are…; j) radar.

Exercise 16. Find in the text sentences containing ing-forms and find out whether they are Participles I, Gerunds or Verbal Nouns.

Exercise 17. Find in the text the information about digital systems and fiber optics. Translate these sentences in writing.

Exercise 18. Match the title corresponding to each of the given descriptions.

Titles: Analogue Computer; Computer; Digital Computer; Central Processing Unit.

1. The central electronic unit in a computer which processes input information, and information from the store, and produces the output information. This unit and the store form the central part of the computer.

2. A computer in which numerical magnitudes are represented by physical quantities such as electric current, voltage or resistance.

3. An electronic device which accepts data, applies a series of logical processes to it, and supplies the results of these processes as information. The device is used to perform mathematical calculations at a very high speed. This makes them useful for various purposes, such as office calculations, control of industrial processes, and the control of flight paths.

4. A computer that operates on data in the form of digits rather than the physical quantities.

UNIT 3

Read and translate the text.

ELECTRICAL AND ELECTRONICS ENGINEERING (I part)

Electrical and electronics engineering is the largest and most diverse field of engineering. It is concerned with the development, application, and manufacture of systems and devices that use electric power. Among the most important subjects in this field are electric power and machinery, electronic circuits, control systems, computer design, superconductors, solid-state electronics, medical imaging systems, robotics, lasers, radars, consumer electronics, and fibre optics. Despite its diversity, electrical engineering can be divided into four main branches: electric power and machinery, electronics, computers, communications and control.

Electric Power and Machinery. The field of electric power is concerned with the design and operation of systems for generation, transmission, and distribution of electric power. Engineers in this field have brought about several important developments since the late 1970s. One of these is the ability to transmit power at extremely high voltages in both the direct current (DC) and alternating current (AC) modes, reducing power losses considerably. Another is the realtime control of power generation, transmission, and distribution, using computers to analyse the data fed back from the power system to a central station and thereby optimizing the efficiency of the system while it is in operation.

A significant advance in the engineering of electric machinery has been the introduction of electronic controls that enable AC motors to run at variable speeds by adjusting the frequency of the current fed into them. DC motors have also been made to run more efficiently this way.

Electronics. Electronic engineering deals with the research, design, integration, and application of circuits and devices used in the transmission and processing of information. Information is now generated, transmitted, received, and stored electronically on a scale unprecedented in history, and there is every indication that the explosive rate of growth in this field will continue unabated.

Electronic engineers design circuits to perform specific tasks, such as amplifying electronic signals, adding binary numbers, and demodulating radio signals to recover the information they carry. Circuits are also used to generate wave forms useful for synchronization and timing, as in television, and for correcting errors in digital information, as in telecommunications.

Prior to the 1960s, circuits consisted of separate electronic devices — resistors, capacitors, inductors, and vacuum tubes — assembled on a chassis and connected by wires to form a bulky package. The electronics revolution of the 1970s and 1980s set the trend towards integrating electronic devices on a single tiny chip of silicon or some other semiconductive material. The complex task of manufacturing these chips uses the most advanced technology, including computers, electron-beam lithography, micro-manipulators, ion-beam implantation, and ultraclean environments. Much of the research in electronics is directed towards creating even smaller chips, faster switching of components, and three-dimensional integrated circuits.

Words to be remembered:

diverse – (adj) разнообразный, разный	**advance** – (n) успех, прогресс, улучшение; продвижение; достижение
concern – (v) касаться, иметь отношение; иметь дело с	**adjust** – (v) регулировать; налаживать; настраивать
fibre – (n) волокно; нить	
generate – (v) вырабатывать; генерировать	**frequency** – (n) частота; повторяемость (элементов)
transmit – (v) передавать; отправлять; отсылать	**circuit** – (n) электрическая цепь; схема
distribute – (v) распределять; распространять	**processing** – (n) обработка; переработка
mode – (n) вид, форма; метод; способ	**scale** – (n) масштаб; шкала
	rate – (n) темп; скорость
reduce – (v) понижать, ослаблять; уменьшать	**amplify** – (v) усиливать; распространять(ся)

Exercise 19. Translate the following word combinations from the text:

1) development and design;

2) systems for generation, transmission and distribution of electric power;
3) extremely high voltages;
4) the efficiency of the system;
5) the frequency of the current;
6) transmission and processing of information;
7) separate electronic devices;
8) a single tiny chip of silicon;
9) the most advanced technology;
10) three dimensional integrated circuits.

Exercise 20. Complete the following sentences and translate them.

1. The field of electric power is concerned with…
2. A significant advance in the engineering of electric machinery has been…
3. Electronic engineering deals with…
4. Electronic engineers design…
5. Circuits are also used to generate…
6. Much of the research in electronics is directed towards…

Exercise 21. Choose synonyms from the second and third columns to the words in the first column:

I	II	III
1) accurately	1) to carry out	1) to employ
2) to relieve	2) to govern	2) fast
3) to require	3) to get	3) unusual
4) to accomplish	4) quickly	4) to set free
5) to control	5) precisely	5) to complete
6) to use	6) to demand	6) to receive
7) rapidly	7) immediately	7) at once
8) extraordinary	8) extreme	8) to call for
9) instantly	9) to release	9) exactly
10) to obtain	10) to apply	10) to regulate

Exercise 22. Answer the following questions. If you can't, use the text.

1. What is electrical and electronics engineering concerned with?

2. How many branches can electrical engineering be divided into?

3. Can you state them? Do it, please.

4. What do electronic engineers design?

5. Is only silicon used for tiny chips production?

6. What innovations are used in the manufacturing of these chips?

Exercise 23. Read the following text and divide it into paragraphs. Say the main idea of each paragraph.

Electronics has probably undergone more revolutionary steps than any other industry. There are three basic developments in electronics that have given birth to three completely new technological industries The first great technological innovation was the introduction of radio-frequency energy. Microwaves alone offer unparalleled opportunities for communications to business and industry. The second of these was, of course, the transistor and the associated solid-state circuit based on semiconductor technology. The third and latest technology is the laser. It is a light amplifying device having a broad range of applications. Lasers are used for medical applications where the extremely narrow high intensity beam is used for surgery or medical treatment.

Exercise 24. Make up questions to the underlined words.

1. Academician U.N. Denisyuk made a fundamental discovery in the field of holography whish paved the way for three-dimensional television and for larger storage capacities in computers.

2. The foundations of quantum electronics have been developed by the academicians N. Basov and A. Prokhorow.

3. V.I. Kovalenkov was the pioneer to make the first electron valves in 1909.

4. The first amplifying semiconductor devices were developed in the USA in 1948.

5. Ultrasonics was first used for flaw detection by the Russian engineer Sokolov.

6. The French chemist Lavoisier gave the correct theory of combustion after oxygen was discovered.

7. P.N.Yablochkov was a well-known scientist in the field of electrical engineering.

Exercise 25. Paraphrase the following sentences according to the pattern: ***Almost all substances expand, when heated=Almost all substances expand when they are heated.***

1. The chemical energy is partially changed into heat, when transformed into electric energy.
2. While working at the invention, Yablochkov realized the advantages of a transformer.
3. When very young, Edison worked as a newspaper boy.
4. When used in the incandescent lamp, the resistor is in the form of a fine wire.
5. When in Paris, Yablochkov met a scientist also working in the field of electrical engineering.
6. If broken anywhere, the electric circuit will immediately stop carrying a current.
7. Electrons are generating electrical energy, while moving through a wire.
8. If necessary, the electric cell may convert chemical energy into electric energy.

Exercise 26. Read the text below and translate it in writing at home.

Masers

The maser (Microwave Amplification by Stimulated Emission of Radiation) was the first of the quantum electronic devices. Atoms of specific materials are given energy to change their orbital states. This external energy can be triggered by a weak signal so that the atoms give off R-F (radio-frequency) energy at a frequency that is identical to the applied signal.

Early models worked with ammonia gas, but since that time both solid state and gas masers have been produced. Many masers are operated at room temperature while others are cooled to low temperatures for improved operations.

UNIT 4

Read and translate the text.

ELECTRICAL AND ELECTRONICS ENGINEERING (II part)

Communications and Control. Engineers work on control systems ranging from the everyday, passenger-actuated, such as those that run a lift, to the exotic, such as systems for keeping spacecraft on course. Control systems are used extensively in aircraft and ships, in military fire-control systems, in power transmission and distribution, in automated manufacturing, and in robotics.

Computers. Computer engineering is now the most rapidly growing field. The electronics of computers involve engineers in design and manufacture of memory systems, of central processing units, and of peripheral devices. The field of computer science is closely related to computer engineering; however, the task of making computers more «intelligent» (artificial intelligence), through creation of sophisticated programs or development of higher level machine languages or other means, is generally regarded as the aim of computer science.

One current trend in computer engineering is microminiaturization. Engineers try to place greater and greater numbers of circuit elements onto smaller and smaller chips. Another trend is towards increasing the speed of computer operations through the use of parallel processors and superconducting materials.

Mechanical Engineering. Engineers in this field design, test, build, and operate machinery of all types; they also work on a variety of manufactured goods and certain kinds of structures. The field is divided into (1) machinery, mechanisms, materials, hydraulics, and pneumatics; and (2) heat as applied to engines, work and energy, heating, ventilating, and air conditioning. The mechanical engineer, therefore, must be trained in mechanics, hydraulics, and thermodynamics and must know such subjects as metallurgy and machine design. Some mechanical engineers specialise in particular types of machines such as pumps or steam turbines. A mechanical engineer designs not only the machines that make products

but the products themselves, and must design for both economy and efficiency. A typical example of modern mechanical engineering is the design of a car or an agricultural machine.

Safety Engineering. This field of engineering has as its object the prevention of accidents. In recent years safety engineering has become a speciality adopted by individuals trained in other branches of engineering. Safety engineers develop methods and procedures to safeguard workers in hazardous occupations. They also assist in designing machinery, factories, ships and roads, suggesting alterations and improvements to reduce the possibility of accident.

In the design of machinery, for example, the safety engineers try to cover all moving parts or keep them from accidental contact with the operator, to put cut-off switches within reach of the operator and to eliminate dangerous sharp parts. In designing roads the safety engineers seek to avoid such hazards as sharp turns and blind intersections that lead to traffic accidents.

Words to be remembered:

range – (v, n) распространять; диапазон; класс; протяжённость	**prevention of accidents** – (n) техника безопасности
actuate – (v) приводить в действие, движение; возбуждать	**alteration** – (n) изменение; перемена; переделка; перестройка
apply – (v) применять; приспосабливать	
involve – (v) вовлекать; затрагивать, включать в себя (in); закручивать	**improvement** – (n) усовершенствование, улучшение
relate – (v) относиться, иметь отношение; устанавливать связь	**reduce** – (v) уменьшать; сокращать; понижать; ослаблять
sophisticated – (adj) сложный; усложнённый; утончённый	**cut-off switch** – (n) выключатель
	avoid – (v) избегать, уклоняться
regard – (v) считать; рассматривать; принимать во внимание	**eliminate** – (v) удалять, устранять, исключать
prevention – (n) предотвращение, предохранение, предупреждение	**intersection** – (n) пересечение; точка пересечения

Exercise 27. Find in the text the following English equivalents:

1) передача и распределение энергии;
2) автоматизированное производство;
3) искусственный интеллект;
4) создание сложных программ;
5) более высокий уровень;

6) гидравлика и пневматика;
7) насосы и паровые турбины;
8) экономичность и эффективность;
9) изменение и усовершенствование;
10) движущиеся части (детали);
11) избегать и ликвидировать.

Exercise 28. Translate the following word combinations from the text:

1) passenger actuated systems;
2) power transmission and distribution;
3) rapidly growing field of science;
4) current trends in computer engineering;
5) parallel processors and superconducting materials;
6) heating, ventilating and air conditioning;
7) particular types of machines;
8) to safeguard workers in hazardous occupations;
9) to reduce the possibility of accident.

Exercise 29. Explain in your own words the following terms:

1) automated manufacturing;
2) distribution of electricity;
3) robotics;
4) artificial intelligence;
5) microminiaturization;
6) superconducting materials;
7) to safeguard workers;
8) air conditioning.

Exercise 30. Match the title corresponding to each of the given descriptions.

Titles: Energy; Electrical Energy; Chemical Energy; Radiant Energy; Kinetic Energy; Potential Energy.

1. The capacity for doing work.
2. That part of the energy stored within an atom or molecule which can be released by a chemical reaction.
3. The energy which a body possesses by virtue of its position. It is measured by the amount of work the body performs in passing from that position to a standard position in which the energy is considered to be zero.
4. The energy which a body possess by virtue of its motion.

5. The energy that is transmitted in the form of radiation.

6. The energy associated with electric charges and their movements. It is measured in watt seconds (joules) or kilowatt-hours.

Exercise 31. Think of 6–9 questions covering the contents of the text.

Electric Power

Electric power is generated by converting heat, light, chemical energy, or mechanical energy into electrical energy. Most electrical energy is produced in large powerful stations by the conversion of mechanical energy or heat. The mechanical energy of falling water is used to drive turbine generators in hydroelectric stations, and the heat derived by burning coal, oil, or other fossil fuels is used to operate steam turbines or internal-combustion engines that drive electric generators. Also, the heat from the fissioning of uranium or plutonium is used to generate steam for the turbine generators in nuclear power plants.

Electricity generated by the conversion of light or chemical energy is used mainly for portable power sources. For example, a photoelectric cell converts the energy power from the light into electrical energy for operating the exposure meter in a camera, and a lead-acid battery converts chemical energy into electrical energy for starting an automobile engine. The basic unit for measuring electric power is the watt – the rate at which work is being done in an electric circuit in which the current is one ampere and the electromotive force is one volt. Ratings for power plants are expressed in kilowatts (1000 watts) or megawatts (1 million watts). Electric energy consumption normally is given in kilowatt–hours. Electricity is clean, inexpensive, and easily transported over long distances.

Exercise 32. Answer the following questions; If you can't use the text "Electrical and Electronics Engineering".

1. Where are control systems extensively used?
2. What does electronics of computers involve engineers in?
3. Which is the current trend in computer engineering?
4. What must mechanical engineers be trained in?

5. Which is the most important object of safety engineering?

6. What kinds of methods and procedures do safety engineers develop?

7. What are the main tasks of the safety engineers while machines designing?

Exercise 33. Translate the sentences below in writing.

1. Electric shock occurs upon contact of a body with any source of electricity that causes a sufficient current through the skin, muscles and hair.

2. But electric shock is also used as a medical therapy under carefully controlled conditions.

3. The primary goal of an earthing system is to assure personnel safety and protection of installations against damage.

4. If you touch a 120 volt circuit with one hand, you can escape serious shock in case you have insulating shoes which prevent a low-resistance path to ground.

5. In electronics and electrical engineering a fuse (from the Latin “fusus” meaning to melt) is a type of protection device.

6. A fuse interrupts excessive current so that further damage by overheating or fire is prevented.

7. The fuse is arranged in series to carry all the current passing through the protected circuit.

Exercise 34. Read the tips to prevent an electric shock. Remember them.

1. Shut off the power to all circuits that you are working on.

2. Use a circuit tester to test the circuit to make sure the circuit is definitely not drawing power.

3. Never use an aluminum ladder (лестница) when working on any projects because the aluminium is an easy conductor for electricity.

4. Avoid working in wet (влажный, мокрый) areas, always wear rubber boots (резиновые сапоги) and rubber gloves (перчатки) while working.

5. Dry off your hands before grabbing any cords to plug-in (включить) or unplug (выключить) all electrical devices.

UNIT 5

Read and translate the text.

THE FUTURE OF THE ENGINEERING PROFESSION

Among various recent trends in the engineering profession computerization is the most widespread. The trend in modern engineering offices is also towards computerization. Computers are increasingly used for solving of complex problems as well as for handling, storing, and generating the enormous volume of data.

Scientific methods of engineering are applied in several fields not connected directly to manufacture and construction. Modern engineering is characterized by the broad application of what is known as systems of engineering principles.

Engineers in industry work not only with machines but also with people, to determine, for example, how machines can be operated most efficiently by workers. A small change in the location of the controls of a machine or of its position with relation to other machines or equipment, or a change in the muscular movements of the operator, often results in greatly increased production. This type of engineering work is called time-study engineering.

A related field of engineering, human-factors engineering, also known as ergonomics, received wide attention in the late 1970s and 1980s when the safety of nuclear reactors was questioned following serious accidents that were caused by operator errors, design failures, and malfunctioning equipment.

Human-factors engineering seeks to establish criteria for the efficient, human-centred design of, among other things, the large, complicated control panels that monitor and govern nuclear reactor operations.

Words to be remembered:

trend – (n) направление, тенденция	**malfunction** – (n) неисправная работа, аварийный режим
enormous – (adj) громадный, огромный	
volume – (n) объём	**efficiently** – (adv) эффективно, продуктивно
to determine – (v) определять, устанавливать	
relation – (n) отношение, связь, зависимость	**cause** – (v) причинять, вызывать, быть причиной

Exercise 35. Translate the following word combinations:

1) solving of complex problems;
2) enormous volume of data;
3) efficient operation;
4) to cause errors;
5) greatly increased production;
6) a related field of engineering;
7) operator errors;
8) design failures ;
9) malfunctioning equipment;
10) complicated control panels.

Exercise 36. Explain in your own words the meaning of the terms:

1) computerization;
2) efficient;
3) ergonomics;
4) malfunction;
5) monitoring;
6) volume of data;
7) distance learning;
8) communication.

Exercise 37. Answer the questions.

1. What is the most widespread trend in the engineering profession?
2. What are computers used for in modern engineering?
3. What is modern engineering characterized by?
4. What approaches are used in modern engineering?
5. What is «ergonomics»?
6. What does human-factors engineering deal with?
7. Why did this branch of engineering receive wide attention in 1970s and 1980s?

Exercise 38. Translate into English.

1. Компьютерная индустрия – наиболее быстроразвивающееся производство.
2. Компьютерное управление автоматизированными производственными линиями открывает новые горизонты для производства дешёвых и качественных товаров.
3. Замена аналоговых систем на цифровые является крупным достижением в сфере коммуникации.

4. Этот университет широко известен своими технологиями дистанционного обучения.

5. Малый вес пластмасс и хорошие электроизоляционные свойства позволяют использовать их в радиоэлектронике и электроприборах, а также вместо металлов.

6. Развитие систем электронной коммуникации за последние пять лет стимулировало производство соответствующих программных продуктов компаний-разработчиков.

Exercise 39. Read the text below. Pay attention to the functions of internet.

We live in multi-media society. How does the internet affect our lives? It can be very helpful to people who carefully choose websites that they visit. The internet can increase our knowledge of the outside world; there is much high-quality information that can help us to understand many fields of study: science, medicine, the arts and so on. In this global network you can find any information in a few minutes. Otherwise you would have to search for the necessary information in directories, libraries or on the phone for a long time.

One of the most valuable functions of the internet is its information function. The internet keeps people informed about current events, as well as the latest achievements in science and culture. Recently a system of distance learning became popular. You can study foreign languages and even study in universities. Individual educational programs can be developed especially for you. The internet is also widely used in business. Thanks to the internet, we have rapid connections with partners from all comers of the world. You can even conduct negotiations, hear and see your contacts, and exchange graphic and textual information.

Exercise 40. Match the following word combinations from the above text:

1. Индивидуальная программа обучения.	1. Necessary information.
2. Проводить переговоры.	2. To develop programs.
3. Обмениваться информацией.	3. Distance learning.
4. Новейшие достижения.	4. Individual educational program.
5. Дистанционное обучение.	5. To conduct negotiations.

6. Разрабатывать программы.	6. Rapid connection.
7. Быстрая связь.	7. Latest achievements.
8. Необходимая информация.	8. To exchange information.

Exercise 41. Find out which of the listed below statements are true/false/.

1. Scientific methods of engineering are applied in several fields not connected directly with manufacture and construction.

2. Engineers in industry work only with machines.

3. Time–study engineering results in greatly increased production.

4. Ergonomics received wide attention only in the late 1990s.

5. Serious accidents were caused by operating errors, design failures and malfunctioning equipment.

6. Human–factors engineering is only connected with the nuclear reactor operations.

Exercise 42. Retell the text about the future of the engineering profession. Try to use words and word combinations from the exercise 1 and exercise 2.

UNIT 6

Read and translate the text.

HISTORY OF ROBOTICS

The concept of robots dates back to ancient times, when some myths told of mechanical beings brought to life. Such automata also appeared in the clockwork figures of medieval churches, and in the 18th century some clockmakers gained fame for the clever mechanical figures that they constructed. Today the term automaton is usually applied to these handcrafted, mechanical (rather than electromechanical) devices that imitate the motions of living creatures. Some of the "robots" used in advertising and entertainment are actually automata, even with the addition of remote radio control.

The term robot itself was derived from the Czech word robota, meaning "compulsory labour". It was first used by the Czech novelist and playwright Karel Chapek, to describe a mechanical device that looks like a human but, lacking human sensibility, can perform only automatic, mechanical operations. Robots as they are known today do not only imitate human or other living forms, True robots did not become possible, however, until the invention of the computer in the 1940s and the miniaturization of computer parts. One of the first true robots was an experimental model designed by researchers at the Stanford Research Institute in the late 1960s. It was capable of arranging blocks into stacks through the use of a television camera as a visual sensor, processing this information in a small computer.

Computers today are equipped with microprocessors that can handle the data being fed to them by various sensors of the surrounding environment. Making use of the principle of feedback, robots can change their operations to some degree in response to changes in that environment. The commercial use of robots is spreading, with the increasing automation of factories, and they have become essential to many laboratory procedures. Japan is the most advanced nation exploring robot technology. Nowadays robots continue to expand their applications.

Words to be remembered:

automata – (n) автоматы, мн. число от *an automation* – автомат	**stack** – (n) ряд; куча; груда
	perform – (v) выполнять; совершать; использовать
apply – (v) применять; употреблять	
handcrafted – (adj) умело, искусно изготовленный вручную	**handle** – (v) обрабатывать; перерабатывать
motion – (n) движение	**feed** – (v) заправлять; закладывать; поддерживать
advertise – (v) рекламировать; помещать объявление	
	feedback – (n) обратная связь
addition – (n) дополнение; добавка; увеличение	**degree** – (n) степень; ступень
	is response to – (n) в ответ на
remote – (adj) дистанционный; отдалённый; удалённый	**spread** – (v) распространять(ся), расширяться
derive – (v) (по)заимствовать	**essential** – (adj) важный; существенный; необходимый
compulsory – (adj) обязательный	
capable – (adj) способный; умелый	**advanced** – (adj) передовой; продвинутый
lack – (v) недоставать; не иметь; испытывать недостаток	**expand** – (v) увеличивать(ся); расширять(ся)
arrange – (v) располагать; классифицировать; приводить в порядок	

Exercise 43. Find the following equivalents in the text:

1) дистанционное управление,
2) механические устройства;
3) выполнять операции;
4) изобретение компьютера;
5) экспериментальная модель;
6) обрабатывать информацию;
7) оснащать микропроцессорами;
8) перерабатывать данные;
9) принцип обратной связи;
10) коммерческое использование;
11) увеличивающаяся автоматизация;
12) лабораторные исследования;
13) самые передовые технологии;
14) расширять применение роботов.

Exercise 44. Form five sentences combining suitable parts of the sentences given in columns I and II.

I	II
1. Today the term automation is applied to the	1) The Stanford Research Institute in the late 1960s

2. Robot is a mechanical device that	2) Making use of the principle of feedback
3. The first experimental model of robot was designed by the researchers at	3) Devices that imitate the motions of living creatures
4. Modern robots can change their operations to some degree	4) Can perform only automatic, mechanical operations
5. The commercial use of robots is spreading with the increasing automation of factories	5) And they have become essential to many laboratory procedures

Exercise 45. Translate the sentences below. Pay attention to the ing-forms.

1. The first experimental robot model was capable of arranging blocks into stacks through the use of a television camera as a visual sensor, processing this information in a small computer.

2. Robots have been programmed for filling thousands of factory jobs. They can do things that are dangerous or boring for humans.

3. Robots can handle hazardous materials or undertake operations potentially harmful for human beings.

4. Robotic arms are used for manufacturing in space.

5. Many industrial jobs that used to be done by humans are increasingly being done by robots.

6. Computers today are equipped with microprocessors that can handle the data being fed to them by various sensors of the surrounding environment.

Exercise 46. Choose the correct forms.

1. Our scientists (have solved, has solved, have been solved) a lot of important problems.

2. This law (has, have, had) been discovered by the end of the 19th century.

3. This compound (was obtained, has obtained, has been obtained) some time ago.

4. Everything is ready. The two substances (are mixed, have been mixed, were mixed) just. You may begin your experiment.

5. Don't enter the laboratory, a dangerous experiment (has been carried on, is being carried on, are carried on).

6. Ernest Rutherford proved experimentally that the positively charged nucleus of an atom (is, has, have) negatively charged electrons revolving round it and attracted to it.

7. The study of semiconductors (was enriched, has enriched, have enriched) physics with new ideas and laws dealing with electrical phenomena.

Exercise 47. Find in the text sentences containing the Passive Constructions. Translate them in writing.

Exercise 48. Answer the following questions.

1. The concept of robots dates back to ancient times, doesn't it?
2. Where did such automata appear?
3. What kind of control is used in advertising and entertainment «robots»?
4. Where was the term robot derived from?
5. What did the Czeck novelist and playwright Karel Chapec want to describe using the term «robot»?
6. When did true robots become possible?
7. Where was the first experimental model of robot designed?
8. What are the results of commercial use of robots?
9. Is Japan the most advanced nation exploring robot technology?

Exercise 49. Read the text below. Add information of your own experience.

There are different situations, where robot's help is needed, for example, in search and rescue operations, mine and bomb detection, scientific exploration, etc. Scientists work out different methods of robot's moving and improve distant control. For example, a special camera helps operators of search and rescue robot to make view of environment where the robot is. There were suggested two types of cameras: the virtual 3D display with an «elevated perspective» and the virtual 3D display with an «close-in perspective». The goal of the 3D display is to provide a workplace for collaborative understanding between the human and robot. Scientists made experiments with the help of people of different ages and genders and looked how they coped with a task of operating robot on distance. They did not see the machine, but with virtual cameras they

created maps of environment. Such experiments help to investigate the errors of scientists and to avoid hardships in crucial situations when errors are impossible.

Exercise 50. Be sure you know the following word combinations. Use them while retelling the above text:

1) to improve distance control – совершенствовать дистанционное управление;
2) to reduce human errors – снижать ошибки человека;
3) collaborative understanding – взаимное понимание;
4) to cope with a task – справляться с заданием (задачей);
5) virtual cameras – эффективные камеры;
6) crucial situation – критическая ситуация.

UNIT 7

Read and translate the text.

TYPES OF ROBOTS

People have long been fascinated with the idea of robots, a term that can broadly be defined as an artificial human being. In the past humans only fantasized about them; today many types of robots are a reality. For example, there are industrial robots, toy robots that entertain us, robots that help in space exploration, robots used in the medical field, in agriculture, in the service sector, etc.

Industrial Robots. Robots today are being utilized in a wide variety of industrial applications. Any job that involves repetitiveness, accuracy, endurance, speed, and reliability can be done much better by robots. For the past 30 years robots have progressively taken over the fully automated production lines of the automobile industry, wherein a chassis of a vehicle is transported along a conveyor belt and is welded, affixed, painted, and assembled by a succession of robot stations. Some of the other industrial jobs performed by robots are palletizing and packaging goods, dispensing jobs, laboratory applications, and robots that pick minute electronic components from trays or strips and accurately place them on printed circuit boards in the electronics industry.

Mobile Robots. Also known as Automated Guided Vehicles, or AG Vs, these are used for transporting material over large sized places like hospitals, container ports, and warehouses, using wires or markers placed in the floor, or lasers, or vision, to sense the environment they operate in. An advanced form of the AGV is the SGV, or the Self Guided Vehicle. These robots have the ability of performing tasks that are non-sequential and non-repetitive in environments that are complex and they are defined as intelligent robots.

Telerobots. These robots are used in places that are hazardous to humans, or are inaccessible or far away. A human operator located at a distance from a telerobot controls its action. Some other examples of telerobots are used in laparoscopic surgery. Doctors use remotely located robots to

communicate with their patients, which enables them to treat patients anywhere in the world. Telerobots are also useful in nuclear power plants where they, instead of humans, can handle hazardous material or undertake operations potentially harmful for humans. They are particularly useful for space exploration. They are used for the maintenance of satellites, robotic arms for manufacturing in space, for constructing space ships and space stations, etc.

Service Robots. The Japanese are in the forefront in these types of robots. They can be subdivided into two main types: 1) robots used for professional jobs; 2) robots used for personal use. Personal use robots are becoming more and more popular, with increased sophistication in Artificial Intelligence. Although it is more expensive and difficult to make highly intelligent and sensitive machines, but service robots designed with minimal intelligence are already fairly common, such as the vacuum cleaning robots, pet robots and entertainment robots.

It is evident, the trend is towards developing more and more sophisticated humanoid types of robots, with human-like physical features and intellectual ability.

Words to be remembered:

application – (n) применение; применимость	**dispense** – (v) распределять; раздавать
repetitiveness – (n) шаблон; шаблонная работа	**pick** – (v) выбирать; отбирать; сортировать; собирать; подбирать
accuracy – (n) точность; правильность; требовательность	**minute** – (adj) очень мелкий
	tray – (n) поддон; неглубокий ящик
endurance – (n) выносливость; сопротивление износу; срок службы	**strip** – (n) лента; конвейер
	circuit – (n) схема; контур; цель
reliability – (n) надёжность; прочность	**sequential** – (adj) последовательный
chassis – (n) ходовая часть автомобиля, рама	**accomplish** – (v) выполнять; завершать; достигать
weld – (v) (n) сваривать; сварной шов; сварное соединение	**maintenance** – (n) техническое обслуживание; эксплуатация
affix – (v) прикреплять; присоединять	**surveillance** – (n) наблюдение; надзор
assemble – (v) собирать, монтировать	**sophistication** – (n) усложнение
palletize – (v) штабелировать; складировать; перевозить на поддонах	**provide** – (v) обеспечивать; снабжать
	succession – (n) последовательность

Exercise 51. Find the following English equivalents in the text:

1) различные типы роботов;
2) скорость и надёжность;
3) по конвейерной ленте;
4) укладка и упаковка товаров;
5) контролировать робота;
6) недоступные места;
7) опасные и вредные для людей;
8) техническое обслуживание;
9) для личного пользования;
10) очистка опасных отходов.

Exercise 52. Translate the passage «Industrial Robots» in writing.

Exercise 53. Answer the following questions.

1. What kinds of jobs in industry can be done much better by robots?
2. Where are telerobots used?
3. What is the function of a human operator?
4. Are telerobots useful in nuclear power plants? Why?
5. Telerobots are particularly useful for space exploration. Do you agree? Why?
6. In which areas are personal robots used?
7. Why are personal robots so popular?
8. Which country is in the forefront of service robots use?
9. What is the trend towards developing types of robots?

Exercise 54. Choose the correct form.

1. Any job that involves accuracy, endurance and reliability can (is done, be done, are done) much better by robots.
2. Robots pick minute electronic components from trays or strips and accurately (is placing, are placed, place) them on printed circuit boards in the electronics industry.
3. Telerobots are used in places that (are, is, was) hazardous to humans, or are inaccessible or far away.
4. Today most robots (was used, were used, are used) in manufacturing operations.
5. Robots (are intended, are intending, is intented) for replacement of humans in industrial and dangerous areas.
6. Robots of adaptive operating (has, have, have been) sensor parts.

7. Many software systems and frameworks (had been proposed, have been proposed, has been proposed) to make robots programming easier.

Exercise 55. Explain in English the meaning of the following terms:

1) artificial;
2) monitoring;
3) miniscule components;
4) maintenance;
5) service robots;
6) intelligent machines;
7) personal use robots;
8) telerobot.

Exercise 56. Read the text “Optical Fiber”. Write out new words. Be ready to discuss varieties of fiber application.

An optical fiber is a flexible, transparent fiber made of a pure glass (silica) not much wider than a human hair. It functions as a waveguide, or "light pipe", to transmit light between the two ends of the fiber. The field of applied science and engineering concerned with the design and application of optical fibers is known as fiber optics. Optical fibers are widely used in fiber-optic communications. This permits transmission over longer distances than other forms of communication. Fibers are used instead of metal wires because signals travel along them with less loss and are also immune to electromagnetic interference. Fibers are also used for illumination.

Optical fiber typically includes a transparent core surrounded by a transparent cladding material with a lower index of refraction. Light is kept in the core by total internal reflection. This causes the fiber to act as a waveguide. Fibers that support many propagation paths or transverse modes are called multi- mode fibers (MMF), they are used for short-distance communication links. Single-mode fibers are used for most communication links longer than 1,050 meters (3,440 ft).

Joining lengths of optical fiber is complex. The fibers ends must be carefully cleaved, then spliced together either mechanically or by fusing them together with heat. There are special optical fiber connectors for removable connections.

Exercise 57. Complete the following statements. Use the text «Optical Fiber».

1. An optical fiber is…
2. Optical fibers are widely used in…
3. Fibers are used instead of metal wires because…
4. Fibers are also used for…
5. Optical fiber typically includes…
6. Multi-mode fibers generally have…

Exercise 58. Find answer to the following questions in the text «Optical Fiber».

1. What kind of material is used for fiber production?
2. What is the width of an optical fiber?
3. Why are optical fibers widely used in fiber-optic communications?
4. What does optical fiber typically include?
5. What is the difference between multi-mode fibers and single-mode fibers?
6. Where are multi-made fibers used?
7. Where are single-mode fibers used?

Exercise 59. Translate the sentences below into English in writing.

1. С ним необходимо немедленно поговорить по этому вопросу.
2. Этот эксперимент будет закончен в срок.
3. Телероботы успешно применяются там, где опасно для человека.
4. Эти виды связи осуществляются при помощи оптоволоконной технологии.
5. Мне предложили очень интересную работу.
6. Об областях применения оптического волокна много говорят.
7. Волокна используют вместо металлических проводов, так как по ним сигналы идут с меньшими потерями и они невосприимчивы к электромагнитным помехам.
8. Вам объяснят, какие вещества необходимы для проведения этого опыта.

UNIT 8

Read and translate the text.

ROBOTICS

Robot is a mechanical artificial agent. Robots are intended for replacement of humans in industrial and dangerous areas. The word robot can refer to both physical robots and virtual software agents. Before appearance of robots it was accepted as norm that they would be human-like. But industrial robots are never human-like, if during designing it was not the main goal.

Robot can submit to commands of operator or work according to a plan which was created before. Also it can run with the help of artificial intelligence technology. These tasks help to facilitate or replace human labor in building, manufacturing, work with harmful materials.

In robot's structure there is mechanical part and operating system of this part, which gets signals from manipulation system of sensor part. Mechanical part is divided into manipulation system and system of moving. Manipulators in mechanical part for robots are analogs of human arms. They include 2 types of mobile branches*:*

- for forward movement;
- for angular displacement.

For robotic engineers, the physical appearance of a machine is less important than the way its actions are controlled. For many people, if a machine looks anthropomorphic or zoomorphic, especially if it is limb-like (e.g. a simple robot arm), or has limbs, or can move around, it would be called a robot. There are many variations in definitions of what exactly is a robot. Therefore, it is sometimes difficult to compare numbers of robots in different countries. To try to provide a universally acceptable definition, the International Organization for Standardization gave a definition of robot in ISO 8373, which defined a robot as «an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which may be either fixed in place or mobile for use in industrial automation applications». This definition is to be used when

comparing the number of robots in each country. In spite of the ISO definition, countries, such as the USA and Japan, have different definitions of robots. Japan, for example, lists very many robots partly because more machines are counted as robots. Both Japan and the USA are important players in the development of robotics. The Robotics Institute of America (RIA) defines a robot as: 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 RIA recognizes four classes of robots:

1. Handling devices with manual control.
2. Automated handling devices with predetermined cycles.
3. Programmable, servo-controlled robots.
4. Robots capable to acquire information from the for intelligent motion.

For movement on open territory usually wheeled or walking or caterpillar system is used. This is the most universal type of movement systems. For uneven surface there are hybrid constructers which blend together different types. Movements along mono railing or on ruts are used at industrial enterprises.

Robot software is the coded commands that tell a mechanical device (known as a robot) what tasks to perform, as well it is used to control robot's actions. Robots programming is a nontrivial task. Many software systems and frameworks have been proposed to make robot programming easier.

Words to be remembered:

facilitate – (v) облегчать, упрощать	**predetermined** – (adj) заданный; заранее установленный
replacement – (n) замена, замещение	
accept – (v) принимать; допускать	**acquire** – (n) приобретать; овладевать
harmful – (adj) вредный, пагубный	**uneven** – (adj) неровный; шероховатый
branch – (n) направление; ответвление	**rut** – (n) колея; борозда
forward – (adv) вперёд; дальше	**blend** – (n) смешивать; сочетаться
angular – (adj) угловой	**perform** – (v) совершать; выполнять; исполнять
limb – (n) конечность	
displacement – (n) перемещение; смещение; сдвиг	**trivial** – (adj) простой; обыденный
define – (v) определять, давать определение; давать характеристику	**ISO** (International Organization for Standardization) – Международная организация по стандартизации

Exercise 60. Translate the following word combinations from the text:

1) replacement of humans in industrial and dangerous areas;
2) to submit to commands of an operator;
3) mechanical part and operating system of this part;
4) manipulation system and system of moving;
5) variations in definition of a robot;
6) the physical appearance of a machine;
7) handling devices with manual control;
8) automated handling devices with predetermined cycles;
9) programmable servo-controlled robots;
10) wheeled, walking or caterpillar system;
11) the coded commands;
12) teleoperated robots for mine cleaning;
13) to perform and control actions.

Exercise 61. Find the following equivalents in the text:

1) появление роботов;
2) искусственный интеллект;
3) заменять труд человека;
4) система движения;
5) контролировать действия;
6) заранее установленный цикл;
7) сочетать различные типы;
8) движение по монорельсу;
9) программное обеспечение;
10) закодированные команды.

Exercise 62. Find in the text sentences with the Passive Constructions. Translate them in writing at home. Pay attention to the tense.

Exercise 63. Choose the correct form:

1. There (was written, were written, is written) many books about robots.

2. It is necessary to develop principles and algorithms (allowing, allows, allowed) more effective communication and interaction between humans and robots.

3. There are different situations when robot's help (is needed, needs, is needing).

4. Industrial robots (is used, are used, was used) extensively for palletizing and packaging of various manufactured goods.

5. For the first time robots were used (assist, assisted, to assist) in search and rescue operations.

6. Some rescue operations (is, are, was) very dangerous for people.

7. Robotics can surely (is, was, be) a new arena of business development.

Exercise 64. Answer the following questions:

1. What is a robot?
2. Are industrial robots human-like?
3. What is the mechanical part of robot divided into?
4. Which organization gave a definition of a robot?
5. What is the American definition of a robot?
6. How many classes of robots does the RIA recognize?
7. What kinds of robots are used for movement on open territory?
8. Where are movements along mono railing or on ruts used?
9. Are teleoperated robots used for mine cleaning or road building?
10. What makes robots programming easier?

Exercise 65. Choose from list B synonyms to the words of list A:

A	**B**
1. specific;	1. sensitive;
2. in essence;	2. to result in;
3. beam;	3. foundation;
4. delicate;	4. special;
5. at a rapid pace;	5. fundamental;
6. to give rise to;	6. in fact;
7. basis;	7. place;
8. essential;	8. to radiate;
9. spot;	9. quickly;
10. to give off.	10. ray.

Exercise 66. Choose from list B antonyms for the words of list A:

A	B
1. to include;	1. high frequency;
2. in phase;	2. strong;
3. to turn on;	3. on the other hand;
4. narrow;	4. slowly;
5. weak;	5. internal;
6. on the one hand;	6. to exclude;
7. at a rapid pace;	7. innermost;
8. external;	8. wide;
9. outermost;	9. to turn off;
10. low frequency.	10. out of phase.

Exercise 67. Translate the text below. Pay attention to the Modal Verbs.

Three Laws of Robotics are a set of three rules written by Isaac Asimov, which almost all robots appearing in his fiction must obey. Introduced in his 1942 short story "Runaround", the Laws state the following:

1. A robot may not injure human beings or make them any harm.

2. A robot must obey orders given to it by human beings except where such orders would conflict with the First Law.

3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

But it is necessary to be a genius to apply these laws in practice. And it takes robots to understand these laws. Nowadays scientists recognize that laws are good for writing stories but in practice they are useless.

Exercise 68. Do you agree or not? Comment on the following statements.

1. Modern technology is rapidly spreading all over the world.
2. One can easily imagine the life today without any home gadgets.
3. The PCs have become a part of everyday life.
4. The development of science brings only progress.
5. Science and technology should be used only in peacefull purposes.
6. The discovery of microware was a step forward.
7. The virtual reality is an amazing thing.

UNIT 9

Read and translate the text.

ROBOTS IN MANUFACTURING

Today most robots are used in manufacturing operations. The applications of robots can be divided into three categories:

1) material handling;
2) processing operations;
3) assembly and inspection.

Material handling is the transfer of materials, loading and unloading of machines. Materials transfer applications require the robot to move materials or work parts from one place to another. Many of these tasks are relatively simple: robots pick up parts from one conveyor and place them on another. Other transfer operations are more complex, such as placing parts in an arrangement that can be calculated by the robot. Machines loading and unloading operations require 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. The robot positions a spot welder against the automobile panels and frames to join them.

Arc welding is a continuous process in which robot moves the welding rod along the welding seam. Spray painting is the manipulation of a spray-painting gun over the surface of the object to be coated. Other operations include grinding and polishing in which a rotating spindle serves as the robot's tool.

The third application area of industrial robots is assembly and inspection. It is expected to increase because the cost of manual labour is high. The design of the product is an important aspect of robotic assembly. Assembly methods that are satisfactory for humans are not always suitable for ro-

bots. Screws and nuts are widely used for fastening in manual assembly, but the same operations are extremely difficult for a one-armed robot. Inspection is the 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 answers the quality specifications. In nearly all industrial robotic application, the robot provides a substitute for human labour. There are certain characteristics of industrial jobs performed by humans that can be done by 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 (for example: spray painting, spot welding, arc welding, loading and unloading tasks);

3. the workpieces or tools are too heavy and difficult to handle;

4. the operation allows the robot to be used in two or three shifts.

Words to be remembered:

manufacturing – (n) производство; изготовление; обработка	**grasp** – (v) схватывать; зажимать
	spot welding – (n) точечная сварка
application – (n) применение; приложение (силы, усилия)	**continuous** – (adj) непрерывный
	welding rod – (n) электрод для сварки
handling – (n) погрузка; разгрузка; транспортировка	**arc welding** – (n) электродуговая сварка
assembly – (n) 1) монтаж; сборка;. 2) агрегат; узел; комплект	**spray painting** – (n) окраска распылением
	processing – (n) обработка; технология
inspection – (n) осмотр; проверка; инспектирование; надзор	**frame** – (n) 1) корпус; остов; каркас; 2) рама; рамка
transfer – (n) перемещение (деталей с операции на операцию)	**screw** – (n,v) винт; шуруп; завинчивать; закреплять (винтами)
loading – (n) нагрузка; погрузка; навалка; загрузка	**spray painting gun** – (n) распылитель краски
pick up – (v) поднимать; подбирать	**welding seam** – (n) сварочный шов
arrangement – (n) 1) расположение; расстановка; размещение	**grinding** – (n) 1) шлифование; 2) измельчение; дробление
utilize – (v) использовать; утилизировать; применять	**polishing** – (n) 1) полирование; 2) отделка
gripper – (n) захват; клещи; захватное устройство	**shift** – (n) 1) смена; 2) сдвиг, смещение; перемещение

nut – (n) гайка, муфта	**spindle** – (n) шпиндель; вал; ось; валик
substitute – (n) заменитель; заместитель	**hazardous** – (adj) опасный; рискованный

Exercise 69. Find the following equivalents in the text:

1) погрузка и разгрузка;
2) робот оснащён захватом;
3) точечная сварка;
4) электродуговая сварка;
5) окраска распылением;
6) сварочный шов;
7) шлифование и полирование;
8) стоимость ручного труда;
9) технические условия;
10) слишком тяжёлые детали;
11) робот заменяет человека;
12) роботы для сборки.

Exercise 70. Explain in English the meaning of the following terms:

1) material handling;
2) a gripper;
3) a welding seam;
4) manual labour;
5) assembling;
6) inspection;
7) spot welding;
8) spray painting;
9) industrial robot;
10) polishing.

Exercise 71. Find in the text sentences with Modal Verbs. Translate them.

Exercise 72. Choose the correct forms:

1. High purity silicon crystals are widely employed in devices (using, used, use) in power electronics.

2. The results of this experiment (have, having, has) been discussed at the seminar.

3. The law (had been, has been, have been) formulated by the 19th century.

4. The rate of the reaction was very slow because these two gases (are being mixed, had been mixed, have been mixed) before the temperature was raised.

5. Copper oxide and selenium (are, is, has) always p-type. Zink oxide (is, are, have) always n-type.

6. Electrical conductivity of semiconductor is one of the (more, most, much) important physical properties.

7. The importance of atomic energy will grow still more when fast neutron reactors (will be used, are used, is used) on a large scale.

Exercise 73. Answer the questions.

1. How are robots used in manufacturing?
2. What is “material handling”?
3. What does a robot need to be equipped with to do loading and unloading?
4. What does robot manipulate in robotic processing operation?
5. What is the most common application of robots in automobile manufacturing?
6. What operations can be done by robot in car manufacturing industry?
7. What are the main reasons for using robots in production?
8. How can robots inspect the quality of products?
9. What operations can be done by robots in hazardous conditions?

Exercise 74. Translate the text below in writing.

Nanotechnology

Nanotechnology comprises technological developments on the nanometer scale, usually 0,1 to 100 nm (1/1,000 um, or 1/1,000,000 mm). A possible way to interpret this size is to take the width of a hair, and imagine something ten thousand times smaller. The term has sometimes been applied to microscopic technology. Nanotechnology is any technology which exploits phenomena and structures that can only occur at the nanometer scale, which is the scale of several atoms and small molecules (u – микрон, um – миллимикрон).

Exercise 75. Choose the appropriate words from the list below:

1. Many methods of making and (хранения) of electric charges were discovered during the 18th century.

2. It was difficult to produce static electricity in large (количествах).

3. Davy used 2000 (элементов) to supply the first arc light.

4. Michael Faraday got a current of electricity in the (катушка).

5. The discovery of the electric lamp (ускоримо) the improvement of the dynamo.

6. Principles of electronic television (были предложены) by B.L. Rosing.

7. Transistors consume (намного меньше) electric power than vacuum tubes.

8. By 1730 scientist (заметили) a close interaction between electricity and magnetism.

9. The basic devices in radio engineering – (радиопередающие) and (радиоприёмные) ones – were developed by Russian scientists.

Were suggested, calls, had noticed, storing, quantities, far less, coil, speeded up, radio transmitting, vacuum tubes, radioreceiving.

Exercise 76. Translate the word combinations; make up sentences with them:

1) minimum amount;
2) labour saving;
3) control systems;
4) precision devices;
5) power supply;
6) semiconductor devices;
7) remote control methods;
8) automatic control systems;
9) small-dimensioned devices;
10) long-distance transmission lines.

UNIT 10

Read and translate the text.

AUTOMATION

Automation is the system of manufacture performing certain tasks, previously done by people, by machines only. The sequences of operations are controlled auto-matically. The most familiar example of a highly automated system is an assembly plant for automobiles or other complex products.

The term automation is also used to describe nonmanufacturing systems in which automatic devices can operate independently of human control. Such devices as automatic pilots, automatic telephone equipment and automated control systems are used to perform various operations much faster and better than could be done by people.

Automated manufacturing had several steps in its development. Mechanization was the first step necessary in the development of automation. The simplification of work made it possible to design and build machines that resembled the motions of the worker. These specialized machines were motorized and they had better production efficiency. Industrial robots, originally designed only to perform simple tasks in environments dangerous to human workers, are now widely used to transfer, manipulate and position both light and heavy workpieces.

The feedback principle is used in all automatic-control mechanisms when machines have ability to correct themselves. Using feedback devices, machines can start, stop, speed up, slow down, count, inspect, test, compare, and measure. These operations are commonly applied to a wide variety of production operations. Computers have greatly facilitated the use of feedback in manufacturing processes. Computers gave rise to the development of numerically controlled machines. Another development using automation are the flexible manufacturing systems (FMS). A computer in FMS can be used to monitor and control the operation of the whole factory.

Many industries are highly automated. The automation technology in manufacturing and assembly is widely used in car and other consumer product industries. In communica-

tions and especially in the telephone industry dialling and transmission are all done automatically. Railways are also controlled by automatic signalling devices, which have sensors that detect carriages passing a particular point. In this way the movement and location of trains can be monitored.

Not all industries require the same degree of automation. Sales, agriculture, and some service industries are difficult to automate, though agriculture industry may become more mechanized, especially in the processing and packaging of foods.

Nevertheless, each industry has its own concept of automation that answers its particular production needs.

Words to be remembered:

sequence – (n) последовательность; чередование; порядок следования	**facilitate** – (v) облегчать; содействовать; способствовать
simplification – (n) упрощение	**dialing** – (n) набор номера телефона
resemble – (v) иметь сходство; походить на; напоминать	**flexible** – (adj) гибкий; легко приспосабливаемый
efficiency – (n) эффективность; производительность; продуктивность	**particular** – (adj) определённый; особенный; специфический
feedback – (n) обратная связь	**degree** – (n) степень; ступень

Exercise 77. Find the following English equivalents in the text:

1) последовательность операций;
2) независимо от контроля;
3) первый шаг в развитии автоматизации;
4) напоминать движения рабочего;
5) выполнять простые задания;
6) принцип обратной связи;
7) внедрение микропроцессоров;
8) компьютер автоматически даёт инструкции;
9) гибкие (легко приспосабливаемые) производственные системы;
10) автоматические сигнальные устройства;
11) степень автоматизации;
12) определенные производственные потребности.

Exercise 78. Explain in your own words the meaning of the following terms:

1) sequence of operations;
2) automated control systems;
3) simplification of work;

4) integrated systems;
5) microprocessors;
6) flexible manufacturing systems;
7) mechanization.

Exercise 79. Complete the following sentences. Use the text. Translate them:

1. Automation is the systems of …
2. The term automation is also used to…
3. The simplification of work made it possible to…
4. Industrial robots, originally designed only to perform…
5. The feedback principle is used in…
6. Computers have greatly facilitated…
7. A computer in FMS can be used to…
8. Each industry has its own concept of…

Exercise 80. Answer the following questions. If you can't, use the text.

1. What is the most familiar example of a highly automated system?
2. Which devices can operate independently of human control?
3. Which is the first step in the development of automation?
4. What was the result of work simplification?
5. What tasks were industrial robots originally designed for?
6. What kinds of operations became possible with the use of feefback devices?
7. Which industries are highly automated?
8. Which industries are difficult to automate?

Exercise 81. Choose the correct form:

1. Electricity can also (is converted, was converted, be converted) efficiently into other forms of energy.
2. Automated control systems perform various operations (much faster and better, more faster and better, much fast and good) than could be done by people.
3. The automobile industry was the first (to be used, to use, is used) an integrated system of production.
4. Computers have (greater, great, greatly) facilitated the use of feedback in manufacturing processes.
5. Modern automated lines (is controlled, are controlled, have controlled) by programmable logic controllers.

6. Any automated control system (can't do, isn't do, hasn't do) without electricity.

Exercise 82. Read the text below. Be ready to express your own point of view.

Advantages and Disadvantages of Automation

The main advantage of automation are:

- Replacing human operators in tedious tasks.
- Replacing humans in tasks that should be done in dangerous environments (i.e. Fire, space, volcanoes, nuclear facilities, under the water, etc).
- Making tasks that are beyond the human capabilities such as handling of too heavy loads, too large objects, too hot or too cold sustances or the requirement to make things too fast or too slow.
- Economy improvement. For example, when an enterprise that has invested in automation technology recovers its investment; when a state or country increases its incomes due to automation like Germany or Japan in the XXI Century or when the humankind can use the internet which in turn use satellites.

The main disadvantages of automation are:

- Technology limits. Nowadays technology is not able to automatizate all the desired tasks.
- Initial costs are relatively high. The automation of a new product requires a huge initial investment in comparison with the unit cost of the product.

Exercise 83. Read and translate the text about crystals. Write out the following words and word combinations, translate and memorize them:

1) a characteristic feature;
2) a crystalline structure;
3) according to a pattern;
4) a space cubic lattice;
5) in the corners of a cube;
6) a good quality crystal;
7) to meet certain standards;
8) with no inclusions and cracks;
9) planar and smooth without steps.

Render the text below in English.

Some Facts About Crystals

A characteristic feature of semiconductors is that they are crystalline. The atoms or molecules making up a crystalline structure are grouped according to definite geometrical patterns. This pattern is known to be a space cubic lattice. The simple cubic lattice contains atoms lying in the corners of a cube and at no other position.

A good quality crystal must meet certain prescribed standards. A crystal may be considered good if it is clear with no inclusions, cracks, must be planar and smooth without steps. Besides these general requirements there are also some special demands connected with the purpose of growing crystals. Accordingly, the crystals may be semiconductors, piezoelectric crystals, or crystals with special mechanical, optical, electrical or electron optical properties.

The techniques that have been used most successfully for growing semiconductor crystals can be divided into three groups: growth from the melt, from the solution and from the vapour phase.

Exercise 84. Translate the sentences in writing:

1. Алмазы используются для резания абразивных материалов, а также для чистовой обработки поверхности твёрдых материалов.
2. Пластмассы производятся в виде листов, тонких плёнок, волокна и гранул.
3. ПВХ (PVC – polyvinyl chloride) – бесцветное твёрдое вещество с отличной устойчивостью к воздействию воды, спиртов, концентрированных кислот.
4. Атомы и молекулы полупроводников имеют кристаллическую решётку.
5. Кремний и германий имеют алмазную кубическую решётку.
6. ПВХ широко применяется при производстве изоляции для проводов.
7. Существует несколько методов выращивания кристаллов: рост из расплавов, из раствора и из паровой фазы.
8. Механизация – это первый шаг, необходимый для развития автоматизации.

UNIT 11

Read the translate the text.

TYPES OF AUTOMATION

Manufacturing is one of the most important application area for automation technology. There are several types of automation in manufacturing. The examples of automated systems used in manufacturing are described below.

Fixed automation, sometimes called "hard automation" refers to automated machines in which the equipment configuration allows fixed sequence of processing operations. These machines are programmed by their design to make only certain processing operations. They are not easily changed over from one product style to another. This form of automation needs high initial investments and high production rates. That is why it is suitable for products that are made in large volumes. Examples of fixed automation are machining transfer lines found in the automobile industry, automatic assembly machines and certain chemical processes.

Programmable automation is a form of automation for producing products in large quantities, ranging from several dozen to several thousand units at a time. For each new product the production equipment must be reprogrammed and changed over. This reprogramming and changeover take a period of non-productive time. 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 numerically controlled machine-tool is a good example of programmable automation. The program is coded in computer memory for each different product style and the machine-tool is controlled by the computer program.

Flexible automation is a kind of programmable automation. Programmable automation requires time to reprogram and change over the production equipment for each series of new product. This is lost production time, which is expensive. In flexible automation the number of products is 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 at a computer terminal without using the production equipment itself. Flexible automation allows a mixture of different products to be produced one right after another.

Words to be remembered:

fixed – (adj) стационарный; неподвижный; закреплённый	**change over** – (v) переналаживать; переходить (к чему-либо)
equipment – (n) оборудование; оснащение	**changeover** – (n) переход; переналадка
sequence – (n) последовательность	**facilitate** – (v) способствовать
initial – (adj) первоначальный; начальный	**non-productive** – (adj) непроизводительный
rate – (n) темп; скорость	**assembly machines** – (n) сборочные машины
require – (v) требовать	

Exercise 85. Find English equivalents in the text:

1) сфера применения;
2) системы, используемые в производстве;
3) фиксированная последовательность операций;
4) перепрограммирование и переналадка;
5) автоматические сборочные машины;
6) контролируемый компьютерной программой;
7) потерянное производственное время;
8) станок с числовым программным управлением;
9) разнообразная продукция.

Exercise 86. Translate the following word combinations:

1) the most important application;
2) fixed or “hard” automation;
3) certain processing operations;
4) from one product style to another;
5) machining transfer lines;
6) products in large quantities;
7) several thousand units at a time;
8) to code in computer memory;
9) to produce one after another;
10) flexible automation.

Exercise 87. Explain in your own words the meaning of the following terms:

1) automation technology;
2) fixed automation;
3) sequence of operations;

4) high initial investments;
5) non-productive time;
6) programmable automation;
7) computer terminal;
8) the changeover of the equipment.

Exercise 88. Answer the following questions. If you can't, use the text.

1. What is the most important application of automation?
2. What is fixed automation?
3. What does the form of fixed automation need?
4. Which is the best example of programmable automation?
5. What are the limitations of programmable automation?
6. What are the advantages of flexible automation?
7. Is the number of products in flexible automation limited? Why so?
8. Where is the reprogramming of the equipment in flexible automation done?
9. Is it possible to produce different products one after another using automation technology?

Exercise 89. Choose the correct form:

1. The modern world of high technology (is possible, are possible, were possible) mainly due to the development of the computer.
2. In the office personal computers may (be used, is used, are used) for word processing, bookkeeping, storage and handling of necessary information.
3. The Swedish Anders Celsius was the first to propose the use of a scale in which the interval between the freezing and boiling points of water (was divided, is divided, are divided) into 100 degrees.
4. World famous authors and publishers (is said, to say, say) that the Internet violates their copyright because web-programmers put all kinds of books, pictures, music, films and programs free on the Internet reducing their profits.

5. Television (informing, informs, inform) people about current events, the latest developments in science and politics, and offers different programmes.

6. Can you imagine a situation when all devices (produce, produces, producing) electricity would stop operating?

7. Computers (are increasingly used, are increasingly using, is increasingly used) for solving complex problems as well as for handling, storing and generating the enormous volume of data modern engineers must work with.

Exercise 90. Render the text below in English.

Уильям Томсон, английский физик, является одним из основателей термодинамики и кинематической теории газов. Член Лондонского Королевского общества с 1851 года; с 1890 по 1895 гг. – его президент. Учился в университетах Глазго и Кембриджа. В 1892 году за научные заслуги получил титул лорда Кельвина. Ещё будучи студентом Томсон опубликовал ряд работ по приложению рядов Фурье к различным разделам физики. В 1845 году он разработал электрический метод получения изображений, затем под влиянием Дж. П. Джоуля занялся фундаментальными проблемами теории теплоты, предложил абсолютную шкалу температур и ввёл понятие рассеяния энергии. В 1856 году предсказал явление переноса тепла электрическим током. Томсон занимался также различными вопросами гидродинамики (теория приливов, распространение волн по поверхности), астрофизики (теория происхождения зодиакального света), геофизики (теория охлаждения зелёного шара). Усовершенствовал зеркальный гальванометр и магнитный компас, сконструировал множество физических приборов. Почётный член Петербургской Академии Наук (1896 г.). Умер в 1907 г., похоронен в Лондоне.

Exercise 91. Memorize the following terms. Render the text about W. Tomson:

1) fouirer series – ряды Фурье;

2) part, section – раздел;

3) theory of heat – теория теплоты;

4) absolute scale of temperatures – абсолютная шкала температур;

5) dispersion of energy – рассеяние энергии;

6) heat transfer – перенос тепла;

7) theory of tides – теория приливов;

8) spreading of waves – распространение волн;

9) theory of zodiac light origine – теория происхождения зодикального света.

Exercise 92. Ask questions to your groupmates.

1. Where did Tomson study?
2. What did Tomson publish when he was a student?
3. Which problems did he solve under the influence of J.P. Joyle?
4. What kind of phenomenon did he preduct in 1856?
5. Was he interested in hydrodynamics?
6. What theories did he develop?
7. When did he die?
8. Where was he buried?

UNIT 12

Read and translate the text.

OPTICAL FIBER

Fiber optics, though used extensively in the modern world, is a fairly simple and old technology. Guiding of light by refraction, the principle that makes fiber optics possible, was first demonstrated by Daniel Colladon and Jacques Babinet in Paris in the early 1840s.

Daniel Colladon first described this «light fountain» or «light pipe» in an 1842 article titled «On the reflections of a ray of light inside a parabolic liquid stream». John Tyndall included a demonstration of it in his public lectures in London some years later. He also wrote a book about the nature of light in 1870.

In 1880 Alexander Graham Bell and Sumner Tainter invented the «Photophone» at the Volta Laboratory in Washington, D.C., to transmit voice signals over an optical beam. Charles K. Kao and George A. Hockham were the first to promote the idea that the attenuation in optical fibers could be reduced below 20 decibels per kilometer (dB/km), making fibers a practical communication medium. This discovery earned Kao the Nobel Prize in Physics in 2009.

An optical fiber is a cylindrical dielectric waveguide that transmits light along its axis, by the process of total internal reflection. The fiber consists of a core surrounded by a cladding layer, both of which are made of dielectric materials. To confine the optical signal in the core, the refractive index of the core must be greater than that of the cladding. The index of refraction is a way of measuring the speed of light in a material. Light travels fastest in a vacuum, such as outer space. The speed of light in a vacuum is about 300,000 kilometers (186,000 miles) per second. Index of refraction is calculated by dividing the speed of light in a vacuum by the speed of light in some other medium. The index of refraction of a vacuum is therefore 1, by definition. The typical value for the cladding of an optical fiber is 1.52. The larger the index of refraction, the slower light travels in that medium. The signal using optical fiber for communication will travel at around

200 million meters per second. To travel 1000 kilometers in fiber, the signal will take 5 milliseconds to propagate.

Glass optical fibers are almost always made from silica, but some other materials, such as fluorozirconate, fluoroaluminate, and chalcogenide glasses as well as crystalline materials like sapphire, are used for longer-wavelength infrared or other specialized applications. Silica and fluoride glasses usually have refractive indices of about 1.5, but some materials such as the chalcogenides can have indices as high as 3. Typically the index difference between core and cladding is less than one percent.

Silica exhibits fairly good optical transmission over a wide range of wavelengths. It can be drawn into fibers at reasonably high temperatures, and has a fairly broad glass transformation range. Silica fiber also has high mechanical strength against both pulling and even bending, if that the fiber is not too thick and that the surfaces have been well prepared during processing. Silica is also relatively chemically inert. In particular, it is not hygroscopic (does not absorb water). Silica glass can be doped with various materials. One purpose of doping is to raise the refractive index (e.g. with Germanium dioxide (GeO_2) or Aluminium oxide (Al_2O_3). Silica fiber also exhibits a high threshold for optical damage. This property ensures a low tendency for laser-induced breakdown. This is important for fiber amplifiers when utilized for the amplification of short pulses. Because of these properties silica fibers are the material of choice in many optical applications, such as communications, fiber lasers, fiber amplifiers, and fiber-optic sensors.

Words to be remembered:

fiber – (n) волокно; фибра	**cladding** – (n) покрытие; оболочка
guide – (v) управлять; направлять	**index** (pi. indices) – (n) показатель (мн.ч. показатели)
confine – (v) ограничивать	
refraction – (n) преломление; рефракция	**propagate** – (v) распространять(ся) (о волнах колебания)
pull – (v) тянуть, растягивать, тащить	**silica** – (n) кремнезём
reflection – (n) отражение	**fluorozirconate** – (n) фтороцирконий
bend – (v) сгибать; изгибать; гнуть; направлять	**aluminate** – (n) соль алюминиевой кислоты; алюминат
angle – (n) угол; угольник	**scattering** – (n) рассеивание

transmit – (v) посылать, отправлять; передавать; пропускать	**draw** – (v) вытягивать; протягивать; волочить (проволоку)
waveguide – (n) волновод	**dope** – (n) добавка; присадка
axis (pl. axes) - (n) ось (мн. ч. оси)	**amplifier** – (n) усилитель
core – (n) сердцевина; сердечник; жила (кабеля)	**attenuation** – (n) затухание (колебаний); уменьшение; ослабление

Exercise 93. Find in the text equivalents to the following word combinations:

1) отражение луча света;
2) перпендикулярно поверхности;
3) предельный угол среды;
4) передавать голосовые сигналы по оптическому лучу;
5) цилиндрический волновод из диэлектрика;
6) сердцевина, окружённая оболочкой;
7) оптическая передача в широком диапазоне длин волн;
8) крайне низкий коэффициент поглощения и рассеивания;
9) высокая механическая прочность на растяжение и изгиб;
10) повышение показателя преломления;
11) усиление коротких импульсов.

Exercise 94. Explain in your own words the meaning of the following terms:

1) dielectric materials;
2) vacuum;
3) attenuation in optical fibers;
4) communication medium;
5) range of wavelengths;
6) doping.

Exercise 95. Answer the following questions. If you can't, use the text.

1. What is the principle that makes fiber optics possible?
2. Who was the first to describe this «light pipe»?
3. For what purpose did Bell and Tainter invent the «photophone»?
4. Who promoted the idea of attenuation reduction in optical fibers?
5. How many decibels per kilometer could attenuation be reduced?

6. What is an optical fiber like?

7. What does the fiber consist of?

8. What is the speed of the signal using optical fiber for communication?

9. Why is silica used for fiber production?

10. In which optical applications are silica fibers used?

Exercise 96. Find in the text "Optical Fiber" sentences containing the information about silica properties. Translate them in writing.

Exercise 97. Put down the title corresponding to each of the given descriptions.

Titles: Electric Field; Direct Current; Alternating Current; Electromagnetic Radiation; Continuous Wave; Electromagnetic Spectrum.

1. Radiation consisting of waves of energy associated with electric and magnetic fields. This radiation is emitted in units called photons.

2. The range of frequencies over which electromagnetic radiations are propagated. The lowest frequencies are radio waves, increases of frequency produce infrared radiation, light ultraviolet radiation, X-rays, gamma-rays and finally the radiation associated with cosmic rays.

3. Radio or radar transmissions which are generated continuously and not in short pulses.

4. An electric current flowing always in the same direction.

5. A flow of electricity which, after reaching a maximum in one direction, decreases, finally reaching a maximum in the opposite direction, the cycle being repeated continuously. The number of such cycles per second is frequency.

6. The region near an electric charge, in which a force is acting on a charged particle.

Exercise 98. Translate the following sentences with infinitive constructions.

1. Fiber optics is known to be extensively used in the modern world.

2. Communication is supposed to have no limits nowadays.

3. At present the most efficient semiconductors seem to be silicon and germanium.

4. We know the index of refraction of a vacuum to be a way of measuring the speed of light in a material.

5. Energy battery is known to possess two terminals (– and +).

6. In some countries the nuclear power plants are believed to produce about 80 per cent of the whole amount of energy.

7. The first type of a solar battery appears to have been demonstrated in 1954.

8. They are certain to achieve good results if they employ new techniques.

Exercise 99. Read the following Russian phrases and find their English equivalents in the right column. Make up sentences with three of them:

1. Утверждают, что этот метод…	1. This method is considered to…
2. Находят, что этот метод…	2. These phenomena are held to…
3. Предполагают, что эти данные…	3. This method is claimed to…
4. Считают, что этот метод…	4. This method is found to…
5. Полагают, что этот метод…	5. These phenomena are assumed to…
6. Полагают, что они…	6. They are thought to…
7. Допускают, что эти данные…	7. These data are supposed to…
8. Сообщают, что эта теория…	8. These results are said to …
9. Говорят, что эти результаты…	9. This theory is reported to…

Exercise 100. Translate this text without a dictionary and be ready to discuss the properties of the particles mentioned below.

Alpha particles can travel about an inch in the air and can be readily stopped by the skin or by a thin sheet of paper. Beta particles are much lighter particles that come from many radioactive materials such as carbon 14 or strontium 90. they can travel a few feet in the air and penetrate up to a

third of an inch, or more, of body tissue (ткань). They can be readily stopped be a thin sheet of aluminium or an inch of wood. Gamma rays are invisible electromagnetic waves similar to X-rays and radio and television waves. They come from such materials as radioactive cobalt 60 or cesium 137; they can travel hundreds of feet through the air and are highly penetrating. Thick barriers of lead (свинец), concrete (бетон), or earth are needed to stop them.

UNIT 13

Read and translate the text.

OPTICAL FIBER APPLICATION

Optical fiber can be used as a medium for telecommunication and computer networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance communications, because light propagates through the fiber with little attenuation compared to electrical cables.

In practical fibers the cladding is usually coated with a tough resin buffer layer. These layers add strength to the fiber but do not contribute to its optical wave guide properties. Rigid fiber assemblies sometimes have light-absorbing ("dark") glass between the fibers, to prevent light that leaks out of one fiber from entering another. This reduces cross-talk between the fibers. Another important feature of cable its ability to withstand horizontally applied force. It is called maximum tensile strength defining how much force can be applied to the cable during the installation period. Optical fibers can be used as sensors to measure strain, temperature, pressure, etc.

Common uses for fiber optic sensors include advanced intrusion detection security systems. The light is transmitted along a fiber optic sensor cable placed on a fence, pipeline, or communication cabling, and the returned signal is monitored and analysed for disturbances.

Special-purpose optical fiber is constructed with a non-cylindrical core and cladding layer, usually with an elliptical or rectangular cross-section. Some fiber optic cable versions are reinforced with glass yarns. Usage of the glass yarns is more cost effective and there is no loss in mechanical durability of the cable.

An example of a heavy metal fluoride glass is the group, composed of zirconium, barium, lanthanum, aluminium, and sodium fluorides. Their main technological application is as optical waveguides in both planar and fiber form. They are advantageous especially in the mid-infrared (2000–5000 nm) range. Optical fiber is also used in medicine, for example in endoscopes, which are used to view objects through a small hole.

Fibers are widely used in illumination applications. They are used for decorative purposes, including art, toys and artificial Christmas trees.

Attenuation in fiber optics, also known as transmission loss, is the reduction in intensity of the light beam (or signal) with respect to distance travelled through a transmission medium. Attenuation coefficients in fiber optics usually use units of dB/km. Attenuation is an important factor limiting the transmission of a digital signal across large distances. Much research has gone into both limiting the attenuation and maximizing the amplification of the optical signal. Empirical research has shown that attenuation in optical fiber is caused primarily by both scattering and absorption. Rough and irregular surfaces, even at the molecular level, can cause light rays to be reflected in random directions. This is called diffuse reflection or scattering, and it is typically characterized by wide variety of reflection angles. Light scattering depends on the wavelength of the light being scattered. Visible light has a wavelength of the order of one micrometre (one millionth of a meter).

Optical fibers may be connected to each other by connectors or by splicing to form a continuous optical waveguide. The generally accepted splicing method is arc fusion splicing, which melts the fiber ends together with an electric arc. For quicker fastening jobs, a «mechanical splice» is used, but there is still the need for stripping, careful cleaning and precision cleaving. Such joints have higher optical loss and are less robust than fusion splices, especially if the gel is used.

Optical fiber can be used to transmit power using a photovoltaic cell to convert the light into electricity. It is especially useful near the devices creating strong magnetic fields and in these areas metal conductors cannot be used.

Words to be remembered:

flexible – (adj) гибкий; эластичный; легко приспосабливаемый	**maintain** – (v) обслуживать; эксплуатировать; ремонтировать
tough – (adj) прочный; плотный; жёсткий	**reinforce** – (v) усиливать; укреплять; придавать жёсткость; армировать
resin – (n) смола; канифоль	**planar** – (adj) плоский; плоскостной
buffer – (n) буфер; амортизатор; глушитель	**yarn** – (n) нить; пряжа
	cross-section – (n) поперечное сечение

contribute – (v) содействовать; способствовать; вносить вклад	**range** – (n) диапазон; радиус действия; дальность; протяжённость
rigid – (adj) жёсткий; негнущийся; твёрдый; неподвижный	**rough** – (adj) неровный; шероховатый; необработанный
leak – (v) просачиваться; давать течь	**scattering** – (n) рассеивание
sensing – (n) восприятие, чувствительность	**irregular** – (adj) неравномерный; неровный
withstand – (v) выдерживать; противостоять	**random** – (adj) беспорядочный; произвольный
tensile strength – (n) прочность на разрыв	**stripping** – (n) зачистка, обдирка, снятие покрытия
remote – (adj) дистанционный; отдалённый; действующий на расстоянии	**fusion** – (n) расплавление, плавка
	robust – (adj) прочный (о конструкции); жёсткий
strain – (n) натяжение; растяжение; деформация	**splicing** – (n) соединение; сращивание
	rectangular – (adj) прямоугольный
intrusion – (n) вторжение; внедрение	**disturbance** – (n) нарушение нормальной работы (режима)
cleaving – (n) отделение, расслаивание	

Exercise 101. Translate the following word combinations from the text:

1) long-distance communication;
2) light propagation through the fiber;
3) a tough resin buffer layer;
4) light–absorbing glass;
5) tensile strength of a cable;
6) special-purpose optical fibers;
7) mechanical durability of the cable;
8) reduction in intensity of the light beam;
9) wavelength of the light;
10) a continuous optical waveguide;
11) to convert the light into electricity;
12) to create strong magnetic fields.

Exercise 102. Find the following equivalents in the text:

1) распространение света;
2) покрывать плотным слоем смолы;
3) важная особенность кабеля;
4) выдерживать горизонтально направленную силу;
5) прочность на разрыв;
6) поперечное сечение в виде прямоугольника;
7) укреплять стеклянными нитями;
8) более высокие оптические потери;

9) преобразовывать свет в электричество;

10) сильное магнитное поле.

Exercise 103. Choose the correct forms:

1. Optical fiber (are, is, were) especially advantageous for long-distance communications.

2. Some fiber optic cable versions (reinforced, are reinforced, reinforcing) with glass yarns.

3. Attenuation in fiber optics (knew, knowing, is known) as transmission loss.

4. Fusion splicing (melts, melting, melt) fiber ends together with an electric arc.

5. Fibers (are widely using, is widely used, are widely used) in illumination applications.

6. Rough and irregular surfaces cause light rays (to be reflected, being reflected, are reflected) in random directions.

7. In some cases the ends of the fiber (is polished, are polished, is polishing).

Exercise104. Find in the text answers to the following questions.

1. Where is optical fiber advantageous?

2. A tough resin buffer layer adds strength to the fiber, doesn't it?

3. What is the definition of maximum tensile strength?

4. Can optical fibers be used as sensors?

5. Why are glass yarns used for reinforcement of fiber optic cables?

6. What does attenuation in fiber optics mean?

7. What is the unit of attenuation coefficient?

8. What does light scattering depend on?

9. Which methods of connection are used in optical fibers?

10. What are the disadvantages of mechanical fiber splices?

11. Where is optical fiber especially useful?

Exercise 105. Explain in your own words the meaning of the terms below:

1) a bundle;

2) remote sensing;

3) buffer layer;

4) to reinforce;

5) illumination;

6) a connector;

7) to reduce;
8) to polish.

Exercise 106. Translate the sentences with the emphatic constructions.

1. It was B. Pascal that invented the mechanical computer.

2. It is the force of gravitation that makes the satellites move round the Earth.

3. It is Norbert Wiener who is considered to be the father of cybernetics.

4. It was the need for large-scale ballistic computations, which led to the development of electronic computers.

5. It was in 1882 that P. Chebyshev invented the arithmometer performing multiplication and division.

6. It is a fuse that is a device for preventing an excessive current from passing through the circuit.

7. It is radar that is used for locating, identifying or guiding moving objects.

Exercise 107. Read the text below and render it in English.

About the First Incandescent Lamp

The first incandescent lamp for practical use was produced in Russia in 1873 by the great Russian scientist Alexander Lodygin. In his lamp he fixed a small carbon rod of about 2 mm in diameter between two copper conductors. In order to protect the lamp from burning through the lamp's air had been evacuated. Vacuum at the time being far from perfect, this first lamp was short-lived. Its life was measured in hours. In 1890 Lodygin made his first lamps with a metal filament using metals with high melting points, such as tungsten, molybdenum, osmium.

Today the filament of the incandescent lamp is twisted into a spiral. The melting point of tungsten being 3300°, it can be heated to 3000°. At this temperature, however, tungsten begins to evaporate. In order to avoid evaporation of tungsten, today lamps are filled with chemically inert gas, i.e. argon or cripton.

Exercise 108. Find in the above text sentences with the Participial Constructions. Translate them in writing.

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