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Целью данного практикума является формирование коммуникативных умений студентов в таких видах речевой деятельности, как говорение и чтение в ситуациях профессионального общения. Текстовой материал и система упражнений представляют собой хорошую базу для взаимосвязанного развития навыков и умений основных видов речевой деятельности, расширения словарного запаса обучаемых и, следовательно, для основательной подготовки студентов к сдаче экзамена по английскому языку. Практикум содержит аутентичные тексты общепрофессиональной и научно-специальной направленности и разнообразные тренировочные упражнения.

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Содержание

UNIT 1: ENGINEERING EDUCATION

Lesson 1

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

engineering – машиностроение, инженерное искусство;
to design structures, machines, and products – проектировать устройства, инструменты и изделия;
techniques – методы;
tiny electronic circuit – микропроцессор;
guided missile – управляемая ракета;
equipment – оборудование;
electric power and water supply systems – системы электро- и водоснабжения;
to reduce – сокращать;
multitude – множество;
orthopaedic – ортопедический;
emission control – контроль выбросов в окружающую среду;
challenging – многообещающий;
by trial and error – методом проб и ошибок;
performance – производительность.

TEXTWORK

Read and translate the text.

What is Engineering

Engineering is the profession that puts scientific knowledge to practical use. The word engineering comes from the Latin word *ingeniare*, which means to design or to create. Engineers use principles of science to design structures, machines, and products of all kinds. They look for better ways to use existing resources and often develop new materials. Engineers have had a direct role in the creation of most of modern technology – the tools, materials, techniques, and power sources that make our lives easier.

The field of engineering includes a wide variety of activities. For example, engineering projects range from the construction of huge dams to the design of tiny electronic circuits. Engineers may help produce guided missiles, industrial robots, or artificial limbs for the physically handicapped. They develop complex scientific equipment to explore the reaches of outer space and the depths of the oceans. Engineers also plan our electric power and water supply systems, and do research to improve automobiles, television sets, and other consumer products. They may work to reduce environmental pollution, increase the world's food supply, and make transportation faster and safer.

There are a multitude of mechanical engineering advancements that are crucial to our everyday lives, making them easier, faster and more efficient. For example, medical engineering companies are now developing surgical robotic systems for orthopaedic, spinal and dental surgery. Environmental engineers in the UK are producing world-leading technology in emission control. UK based mechanical engineers in the defence industry are creating an innovative protection system for the International Space Station. This describes just a few of the exciting, innovative and challenging projects that mechanical engineers are involved in.

In ancient times, there was no formal engineering education. The earliest engineers built structures and developed tools by trial and error. Today, special college training prepares engineers to work in a certain branch or field of engineering and standards of quality and performance guide them on the job.

TEXT AND VOCABULARY EXERCISES

1. Comprehension exercises.

1.1. Which 2 statements are addressed to in the text?

1. Danger of environmental pollution.
2. Role of engineering in human's life.
3. Engineering activities.
4. Development of surgical robots.
5. Engineering education in ancient times.

1.2. Answer the following questions.

1. What is the main function of the engineer?
2. Is the engineering profession important nowadays?

1.3. Find the answers in the text to the questions below.

1. What does engineering, as the profession, do?
2. What do the engineers look for?
3. What activities are included into the engineering?
4. Where are artificial limbs used for?
5. How did the earliest engineers build structures and develop tools?
6. What mechanical engineering advancements do you now? Give your own examples.
7. What scientific equipment to explore outer space and the oceans invented by engineers?
8. What do the engineers use to design different products?
9. What do we use power and water supply systems for?
10. What standards guide engineers on their jobs?

1.4. Tell if statements below are true or false according to the text. Change a sentence if it's false.

1. The word engineering comes from the Greek word *ingeniare*.
2. Engineers develop new methods for using of existing resources.

3. Engineering projects include the construction of huge dams and the design of tiny electronic circuits.

4. Making transportation faster and safer engineers increase environmental pollution.

5. Mechanical engineering advancements do not influence our everyday lives.

6. Engineering is used in medicine as well.

7. Engineering education was extremely popular in ancient times.

8. The earliest engineers did thorough experiments before building structures and developing tools.

9. Environmental engineers are producing an innovative protection system for the International Space Station.

10. Modern technology is the result of engineering.

1.5. Name the industries where the following products can be used.

1. A bridge. 2. A robot. 3. An airplane. 4. A crane. 5. An assembly line.

2. Vocabulary exercises.

2.1. Find synonyms:

A	B
to mean;	to search for;
to look for;	navigated;
guided;	false;
to increase;	producing;
artificial;	contamination;
to range from… to;	secure;
creation;	education;
pollution;	to denote;
training;	to enlarge;
safe;	vary from ... to.

2.2. Find antonyms:

A	B
complex;	natural;
to reduce;	dangerous;
artificial;	huge;
safe;	narrow;
guided;	attack;
tiny;	slow;
wide;	simple;
defense;	inefficient;
efficient;	uncontrollable;
fast;	enlarge.

2.3. Match definitions with the words below.

science	Any branch or department of systematized knowledge considered as a distinct field of investigation or object of study.
electronic circuit	A computer-controlled machine that is programmed to move, manipulate objects, and accomplish work while interacting with its environment.
robot	A contamination of Earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of ecosystems.
pollution	The condition of the water, air, soil, plants and animals, natural surroundings.
environment	A small piece of semiconducting material containing in an electronic circuit

2.4. Find words in the text which have the following definitions.

1. A self-propelled weapons which are guided in flight toward a target either by remote control or by internal mechanisms.
2. A barrier or special construction which prevents the flow of a liquid or harnesses the river to the production of electricity.
3. The branch of medical science which treats of manual operations for the healing of diseases or injuries of the body.
4. The system which provides water for domestic, industrial and irrigation needs.
5. The mechanical devices which are designed to reproduce the form, and the function, of a lost or absent part.

2.5. Replace the underlined word with a word or a phrase from the text.

1. The chief goal of academic education is to apply scientific knowledge to practical use.
2. There exists a great variety of challenging projects in various fields of science.
3. After installing of the new equipment the number of workers was lowered.
4. This group of researches uses the most advanced methods in their work.
5. To make better the efficiency of this machine we need to use synthetic materials.

2.6. Reorder the words to make up a sentence.

1. with the construction, of, deals, engineering, buildings, roads, bridges.
2. began to, kinds of work, specialize, engineers, in, certain.
3. new fields of, are emerging, and technological, as a result of, engineering, breakthroughs.

4. the structure, materials engineering, various materials, studies, and uses of.
5. design, mechanical engineers, and operate, all kinds of machines.
6. nuclear engineers, nuclear power plants, construct, and design.
7. human use, is, human engineering, machines, to make, the purpose of, for?
8. engineers, a new machine, discovered, the efficiency of.
9. the, computer engineering, current trend in, is, microminiaturization.
10. manufacturing, articles, of, does, by, machinery, making, mean?

2.7. Read the text and fill in the gaps with the words from the box.

based concerned contributed (x2) science occurred attempts learned technology nuclear

Science 1 … to explain how and why things happen. Technology is 2 … with making things happen. Since 1850, science has 3 … much to modern technology. However, technology has often 4 … to science. In addition, not all technology is 5 … on science, nor 6 … is necessary to all 7 … . For example, people made objects of iron for hundreds of years before they 8 … about the changes that 9 … in the structure of the metal during ironmaking. But some modern technologies, such as 10 … power production and space travel, depend heavily on science.

2.8. Fill in the gaps with words in the right column. Change the form if necessary.

1. This machine is capable of performing any operation of very great … .	complex
2. This system can produce a great number of … operations.	engine
3. The industry requires highly … equipment.	develop
4. They observed … in productive efficiency.	reduce
5. The … of this device will take more than a year.	create
6. Scientists decided to launch a new space … program.	explore
7. A new plan was approved after several serious … .	improve
8. These results are of … use.	practice
9. New scientific … make work easier to do.	discover
10. The field of engineering includes a wide … of activities.	vary

3. Text summary.

3.1. Summarize the text using the plot below.

1. The meaning of the word engineering.
2. The role of engineers.
3. Engineering activities.
4. Engineering advancements.
5. Engineering education.

Lesson 2

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

mechanical engineering – машиностроение;
to invent – изобретать;
marvel – чудо, предмет удивления;
to manufacture – производить, изготавливать;
installation – установка;
inspiration – вдохновение, воодушевление;
to be concerned with – занятый чем-л.; связанный с чем-л.;
maintenance – техническое обслуживание;
movable – подвижный;
opportunity – возможность;
heart valves – сердечные клапаны;
artificial limbs – искусственные протезы;
jet engine – реактивный двигатель;
to suit – подходить, соответствовать;
pre-requirement – предварительное требование;
making things happen – осуществлять, реализовывать, создавать;
assessment – оценка;
career prospects – профессиональные перспективы;
computer aided design (CAD) – система автоматизированного проектирования (САПР);
stress analysis – исследование напряжённого состояния;
heat transfer – термодинамика;
to cover – охватывать, освещать ;
supplementary subjects – факультативные предметы;
accountancy – бухгалтерский учёт.

TEXTWORK

Read and translate the text.

Why Study Engineering

Thousands of years ago 'mechanical engineers' invented the wheel. Today's engineers have created the London Eye – the most modern and advanced wheel of the 21st century. The London Eye is a massive mechanical marvel that is placed close to the River Thames. Mechanical engineering played a vital part in the design, manufacture and installation of the Eye, something that was originally believed to be impossible. Now it is both an extremely popular tourist attraction and an inspiration to future engineers.

Mechanical engineering courses in British universities offer the highest quality teaching and research. Mechanical engineers are among the most highly paid professionals in UK business.

Mechanical engineering is concerned with design, development, installation, operation and maintenance of anything that has movable parts. As a result, there are job opportunities for mechanical engineers in practically every field of work, transport, health, defence, manufacturing, entertainment, finance, publishing, building, design and research. Mechanical engineering projects can range from designing heart valves and artificial limbs, clockwork radios and dentists' drills to building racing cars, jet engines or space modules.

A career in mechanical engineering would suit a 'behind the scenes' or 'in front of the camera' type person. The only pre-requirements are high academic qualifications and a passion for learning and enthusiasm for making things happen.

How to choose the right course and university

Mechanical engineering courses vary widely in content, assessment and teaching. Deciding which course to do is no easy task, but your choice can guarantee your future career prospects. The basic mechanical engineering degree course includes certain major subjects – communication, drawing and computer aided design (CAD) and engineering control, electrical machines and power, fluid mechanics, materials, stress analysis, thermodynamics and heat transfer, dynamics and vibration, electronics, manufacturing systems, measurement and instrumentation, statics and structures. Courses can also cover a number of other supplementary subjects, for example – business management, accountancy and informational technologies (IT).

TEXT AND VOCABULARY EXERCISES

1. Comprehension exercises.

1.1. Which of the following statements are addressed to in the text?

1. Invention of the wheel was made by the mechanical engineers.
2. The London Eye is a mechanical marvel.
3. Social rank of engineers in Great Britain.
4. The range of engineering projects.
5. Requirements of personal characteristic for an engineer.
6. Choosing of the course and university.
7. Engineering subjects.

1.2. Answer the following questions.

1. Why have you chosen the career of a mechanical engineer?
2. Which engineering subjects do you study at the University?

1.3. Find the answers in the text to the questions below.

1. How is the most modern and advanced wheel of the 21st century called?
2. What is the London Eye? Does it have any practical use?
3. What does the London Eye mean for engineers?
4. What is mechanical engineering concerned with?
5. How do engineering projects range?
6. Whom does career in mechanical engineering suit?
7. What are the main requirements for an engineer professional?

8. What depends on the choice of an academic course?
9. Which subjects are included into the basic mechanical engineering course?

1.4. Tell if statements below are true or false according to the text. Change a sentence if it's false.

1. Thousands of years ago 'mechanical engineers' invented the wheel which was called the London Eye.
2. The London Eye is a bridge that crosses the River Thames.
3. The London Eye inspires future engineers.
4. Mechanical engineers get high salaries in Great Britain.
5. British universities provide engineering education of the highest quality.
6. Mechanical engineers have plenty of career opportunities.
7. Mechanical engineers are good actors as they can play secondary and leading parts.
8. Mechanical engineering courses are very different.
9. It is very easy to choose the course.
10. Business management is the major engineering subject.

1.5. Say which of the academic subjects below are compulsory and which are supplementary.

1. Computer Aided Design.
2. Electronics.
3. Industrial management.
4. Machines and Power.
5. Materials and Stress Analysis.
6. Accounting.
7. Manufacturing Systems.
8. Labor Safety.

2. Vocabulary exercises.

2.1. Find synonyms:

A	B
massive;	important;
marvel;	training;
vital;	job;
impossible;	main;
inspiration;	wonder;
teaching;	enormous;
opportunity;	to comprise;
career;	enthusiasm;
major;	chance;
to cover;	unbelievable.

2.2. Find antonyms:

A	B
modern;	statics;
close to;	compulsory;
future;	wrong;
professional;	dismantling;
movable;	amateur;
enthusiasm;	far from;
installation;	past;
dynamics;	fixed;
supplementary;	indifference;
right;	outdated.

2.3. Match definitions with the words below.

engineering	The branch of mechanics which treats of the motion of bodies and the action of forces in producing or changing their motion.
design	Inquiry or examination in seeking facts or principles.
research	The art and science by which the mechanical properties of matter are made useful to man in structures and machines.
mechanics	The science, or branch of applied mathematics, which treats of the action of forces on bodies.
dynamics	A plan or scheme formed in the mind of something to be done.

2.4. Find in the text academic subjects according to the descriptions below.

1. The branch of physics which treats of the mechanics of liquids, or of their laws of equilibrium and of motion.
2. The act or the art of representing any object on paper by means of lines and shades.
3. The science which treats of the mechanical action or relations of heat.
4. The branch of mechanics which treats of the equilibrium of forces.
5. The application of computers in the design and manufacture of components used in the production.

2.5. Replace the <u>underlined word</u> with a word or a phrase from the text.

1. <u>Enormous</u> dam was constructed to embank the river.
2. The first horseless carriage which shook, rattled and rolled was a <u>technical miracle</u> of 19^{th} century.
3. Good knowledge of mathematics is necessary in this <u>sphere of activity</u>.
4. The position of a mechanical engineer should <u>agree with</u> his abilities.
5. The engineers <u>assured</u> that those machines would last 5 years.

2.6. Reorder the words to make up a sentence.

1. demands, the development of, skills, workers, new technologies, with, computer and engineering.
2. specialize in, engineering, today, the applied sciences, educational institution, and.
3. are involved in, projects, innovative, the mechanical engineers.
4. benefit from, people, last century, this, mechanical engineering, advancements of.
5. efficiency, a mechanical engineer, products, must design, for economy, and.
6. many, large, in engineering, do, professionals, industries, require, highly educated.
7. manufacture and construction, methods of, engineering, scientific, are applied in.
8. not only, larger and more complex, them, engineers, realize, dream of, structures, but also.
9. work with, in industry, machines, as well as, engineers, with people.
10. deals with, and time-study engineering, the relation to, of a machine, the position, other equipment.

3. Speaking.

3.1. Summarize the text using the plot below.

1. The London marvel of the millennium.
2. Job opportunities for engineers.
3. Professional requirements and characteristics.
4. Engineering courses and subjects to study.

3.2. Find the most appropriate course for each of the following prospective students. Use the Course Guide which follows.

1. A student who has just left school and wants to become a technician.
2. A student who wants to design ships.
3. A student who wants to get an engineering degree and also improve his knowledge of languages.
4. A student who wants a degree eventually but whose qualifications at present are enough to start an HND course.
5. A student who wants to work as an engineer with the air force.
6. A technician employed by a company which installs electrical wiring in factories.
7. A student with a National Certificate in Electrical Engineering who is prepared to spend another two years studying to improve her qualifications.
8. A student interested in how micro-organisms can be used in industry.

ENGINEERING COURSE GUIDE

Higher National Diploma in Electronic and Electrical Engineering. Two years, full-time. For potential electronic and electrical engineers. The first year is common and the second year allows students to specialize in either electronic or electrical engineering subjects. Successful students may continue to a degree course.

National Certificate in Electrical Engineering. One year, full-time. For potential technicians or for those who wish to gain entry to an HND course.

Higher National Certificate Course in Electrical Engineering. Two years, day-release. This course provides the technical education required for senior technicians employed in the electrical installation industry.

Bachelor of Engineering (B Eng) – Mechanical Engineering for Europe. Four years, full-time, including one year study and work attachment in France or Germany.

Bachelor of Engineering (B Eng) – Aeronautical Engineering. Three years, full-time, or four years including one year of professional training in the aircraft industry.

Bachelor of Engineering (B Eng) – Naval Architecture and Ocean Engineering. Three years, full-time.

Bachelor of Science (Engineering) – Mechanical

Bachelor of Engineering (B Eng) – Manufacturing Management. A two-year HND course in engineering followed by two years of technology and management designed to produce managers qualified in high technology.

Lesson 3

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

unique – уникальный;
public health – здоровье населения;
environmental engineering – охрана окружающей среды, экологические технологии;
power engineering – электроэнергетика;
combustion – горение, окисление;
fluidized bed - жидкообразная основа;
air-conditioning application – оборудование для кондиционирование воздуха;
according to – в соответствии с;
urban – городской;
boundaries – границы, рамки;
circumstantial – зависящий от обстоятельств;
subsequently – в результате;
associated with – связанный с;
remote regions – отдалённые местности;
behavior – поведение.

TEXTWORK

Read the text to learn about the principles of the engineering science division.

Principles of the Engineering Science Division

There is no unique principle for or any constancy to the way in which the individual sciences and technologies within engineering are originally placed and subsequently grouped. It may be according to association: public health and environmental engineering are traditionally part of civil engineering because of civil engineering's concern with sanitation. However, medical and chemical principles are required. It may be according to where related technologies exist: thus industrial engineering began and often continues in mechanical engineering.

It may be according to where the basic principles are found. Power engineering and energy are largely electro-mechanical and may be found associated with either mechanical or electrical engineering. As the chemistry of combustion, as in fluidized beds, becomes important in the context of pollution control, furnace design, traditionally part of mechanical engineering, becomes of interest to chemical engineers.

Because of the thermal and energy aspect, heating, ventilation and air-conditioning as well as refrigeration are part of mechanical engineering.

It may be according to the type of system to which application is found. Thus, controls are primarily of interest in mechanical, electrical, chemical and guidance technologies.

It may be according to physical conditions or climate. Rural applications of engineering are usually agricultural and civil while mechanical, electrical and communications technologies are usually imported. Thus rural and primitive and remote regions applications are often, by force of routine, part of civil or agricultural engineering.

Mechanical, electrical, communications technology is largely industrial and urban. Cold regions engineering, which includes topics such as materials and systems behavior at low temperatures and ice mechanics, is a specialty found in places like Alaska, Siberia and the Antarctic. It is clear that the categories in engineering are not fixed. Nor, in practice, are there absolute schemes which define the categories because the boundaries to the divisions are somewhat circumstantial.

TEXT AND VOCABULARY EXERCISES

1.1. Divide the text above into logical parts and give each a suitable title.

1.2. Find in the text the words or phrases which mean the same as:

- промышленное машиностроение;
- единственный в своем роде;
- гражданское строительство;
- контроль за загрязнением;
- здравоохранение;
- применение;
- определять, характеризовать.

1.3. Make up situations using the English equivalents of the words given above.

1.4. Work in pairs and decide whether these statements are true or false.

1. There is no unique principle for or any constancy to the way in which the individual sciences and technologies within engineering are originally placed and subsequently grouped.
2. Medical and chemical principles are not required at all.
3. Power engineering and energy are largely electro-mechanical and may be associated with either chemical or mechanical engineering.
4. Controls are primarily of interest in mechanical, electrical, chemical and guidance technologies.
5. Mechanical, electrical, communications technology is largely rural.
6. Cold regions engineering is a specialty found in places like Alaska, Siberia and the Antarctic.

1.5. Find in text the situations in which the following word combinations are used.

Sciences and technologies; public health and environmental engineering; industrial engineering; mechanical engineering; rural applications; urban.

1.6. Fill in the gaps with the words from the box.

appeared important executing applied engines explanation engineering

The term 1 ___ is a modem one. The new Marriam-Webster Dictionary gives the 2 ___ of the word “engineering” as the practical principles. Nowadays the term engineering means the art of designing, constructing or using 3 ___. But this word is now 4 ___ in a more extended sense. It is applied also to the art of 5 ___ such words as objects of civil and military architecture, in which engines or other mechanical appliances are used. The most 6 ___of them are: civil, mechanical, electrical, nuclear, mining, military, marine and sanitary. In the middle of the 20th century there 7 ___some other new branches of engineering – nuclear and space engineering.

UNIT 2: HISTORY OF ENGINEERING

Lesson 1

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

engine – двигатель;
to transfer – передавать, превращать;
propulsion – силовая установка, двигатель;
to permit – позволять;
piston – поршень;
efficiency – эффективность, коэффициент полезного действия;
to pump – качать; pump *n* – насос;
counterweight – противовес;
valve – клапан;
to spray – впрыскивать;
jet – струя;
extensively – в значительной степени, широко;
devise – прибор, устройство, механизм;
reciprocating – совершающий возвратно-поступательное движение;
flywheel (fly wheel) – маховик;
to accomplish – завершать, выполнять;
crankshaft – коленчатый вал;
alternately – поочерёдно; попеременно;
back and forth – взад и вперёд;
throttle valve – дроссельный клапан;
governor – зд. регулятор;
to maintain – сохранять, поддерживать;
noncondensing – неконденсирующийся.

TEXTWORK

Read and translate the text.

James Watt and Invention of Steam Engine

Steam engine is a mechanical device used to transfer the energy of steam into mechanical energy for a variety of applications, including propulsion and generating electricity. The basic principle of the steam engine involves transforming the heat energy of steam into mechanical energy by permitting the steam to expand and cool in a cylinder equipped with a movable piston. In most power generation applications the steam engines have been replaced by steam turbines because of their low efficiency.

The first piston engine was developed in 1690 by the French physicist and inventor Denis Papin and was used for pumping water. Papin's engine was a crude machine in which the actual work was done by air rather than steam pressure.

The first practical steam engine, the so-called atmospheric engine, was built by the English inventor Thomas Newcomen in 1712. This device had a vertical cylinder and a piston that was counterweighted. Steam admitted to the bottom of the cylinder at very low pressure acted with the counterweight to move the piston to the top of the cylinder. When the piston reached this point, a valve opened automatically and sprayed a jet of cold water into the cylinder. Newcomen's engine was not efficient, but it was sufficiently practical to be used extensively for pumping water from coal mines.

The Scottish engineer and inventor James Watt produced a series of inventions that made possible the modern steam engine. Watt devised a method in which the reciprocating pistons of engines drove a revolving flywheel. He accomplished this by means of a crankshaft, as in modern engines. Watt's other improvements and inventions included application of the principle of double action, whereby steam was admitted to each end of the cylinder alternately to drive the piston back and forth. He also equipped his engines with throttle valves to control speed and also with governors in order to maintain automatically a constant speed of operation.

At the beginning of the 19^{th} century the British engineer and inventor Richard Trevithick and the American inventor Oliver Evans devised successful noncondensing engines using the high-pressure steam.

TEXT AND VOCABULARY EXERCISES

1. Comprehension exercises.

1.1. Which 2 statements are addressed to in the text?

1. The efficiency of steam turbines.
2. Means for pumping water.
3. Principles of the steam engine.
4. Development of the steam engine.
5. James Watt’s biography.

1.2. Answer the following questions.

1. Why did people need in a steam engine?
2. What type of engine is likely to replace all the existing engines?

1.3. Find the answers in the text to the questions below.

1. What kind of a device is the steam engine?
2. What is the work of a steam engine based on?
3. Why has a steam turbine replaced the steam engine?
4. When was the first steam engine build? What was it used for?
5. Who made the first modern steam engine?
6. How does a steam engine work?
7. What was the Watt’s engine equipped with?
8. What did other Watt’s inventions include?
9. When was the first noncondensing engine devised?
10. What steam is used in a noncondensing engine?

1.4. Tell if statements below are true or false according to the text. Change a sentence if it's false.

1. Transformation of heat energy into mechanical makes a steam engine work.
2. The work of the first steam engine was done by water pressure.
3. The first steam engines were used for generating electricity.
4. James Watt improved the steam engine.
5. Steam was admitted to each end of the cylinder simultaneously that made piston move back and forth.
6. It was impossible to control the speed of Watt's engine.
7. A valve sprayed a jet of hot water into the cylinder.
8. Steam engines were used to pump water from coal mines.
9. The first modern steam engine was invented in Great Britain.
10. At present steam engines are mostly replaced by steam turbines.

1.5. Describe steam engines made by the following inventors.

1. Denis Papin. 2. Thomas Newcomen. 3. James Watt. 4. Richard Trevithick and Oliver Evans.

2. Vocabulary exercises.

2.1. Find synonyms:

A	B
to transfer;	to let in;
to involve;	continual;
to replace;	to reach;
efficiency;	rotating;
crude;	to include;
jet;	to substitute;
revolving;	effectiveness;
to accomplish;	to transform;
to admit;	current;
constant;	coarse.

2.2. Find antonyms:

A	B
to permit;	top;
actual;	variable;
practical;	potential;
vertical;	failed;
bottom;	simultaneously;
extensively;	horizontal;
double;	to prevent;
alternately;	rarely;
constant;	theoretical;
successful;	single.

2.3. Find names of parts in the text which have the following definitions.

1. A compound machine by which any physical power is applied to produce a given physical effect.
2. A sliding piece which either is moved by, or moves against, fluid pressure. It is used in steam engines to receive motion from the steam, and in pumps to transmit motion to a fluid.
3. The chamber of a steam engine in which the piston is moved by the force of steam.
4. A mass of metal in one side of flywheel which balances the weight.
5. A heavy wheel attached to a machine which has revolving motion to keep its parts moving at an even speed.
6. A plug or cover which opens or closes to permit or prevent passage of a fluid or steam.

2.4. Replace the underlined word with a word or a phrase from the text.

1. A number of mechanical devices have their own built-in power unit.
2. This apparatus is fitted up with expensive devices.
3. Steam turbines have found their use in driving electric generators and powering ocean liners and large machinery.
4. Nowadays some industries substitute plastics and other synthetics for natural materials.
5. This machine allows a cutting tool to move up and down as well as backwards and forwards.
6. The installation of steam engines helped manufacturers keep production at a high level.
7. Invention of the steam engine enabled the invention of a locomotive.
8. The mechanical engineers thought out the method of more efficient use of fuel.
9. Earlier water pumps were driven with the help of animal power.
10. James Watt introduced valve regulators in his engine.

3. Text summary.

3.1. Summarize the text using the plot below.

1. The basic principle of a steam engine.
2. The invention of the first piston engine.
3. The steam engine of Thomas Newcomen.
4. James Watt and his steam engine.
5. Further improvements of a steam engine.

Lesson 2

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

to spread – распространять;
scale – масштаб;
humankind – человечество;
to experience – испытывать, переживать;
significantly – значительно;
to encourage – вдохновлять, побуждать;
to bring about – вызывать;
to shift from – перемещаться;
in the long run – в длительный период;
pollutant – загрязняющий агент;
to harm – наносить вред;
habitat – естественная среда обитания;
supply – ресурсы;
scarce – редкий, скудный;
brewing – пивоварение.

TEXTWORK

Read and translate the text.

Industrial Revolution

The Industrial Revolution began in Great Britain during the last half of the 18^{th} century and spread through regions of Europe and to the United States during the following century. In the 20th century industrialization on a wide scale extended to parts of Asia and the Pacific Rim. Today mechanized production and modern economic growth continue to spread to new areas of the world, and much of humankind has yet to experience the changes typical of the Industrial Revolution.

The Industrial Revolution is called a revolution because it changed society both significantly and rapidly.

Ever since the Renaissance Europeans had been inventing and using ever more complex machinery. Particularly important were improvements in transportation, such as faster ships, and communication, especially printing. These improvements played a key role in the development of the Industrial Revolution by encouraging the movement of new ideas and mechanisms, as well as the people who knew how to build and run them.

The social changes brought about by the Industrial Revolution were significant. As economic activities in many communities moved from agriculture to manufacturing, production shifted from its traditional locations in the home and the small workshop to factories. In the long run the Industrial Revolution has brought economic improvement for most people in industrialized societies. There have been costs, however. Industrialization has brought factory pollutants and greater land use, which have harmed the natural environment. In particular, the application of machinery and science to agriculture has led to greater land use and, therefore, extensive loss of habitat for animals and plants.

Modern industry requires power to run its machinery. During the development of the Industrial Revolution in Britain, coal was the main source of power. Even before the 18th century, some British industries had begun using the country's plentiful coal supply instead of wood, which was much scarcer. Coal was adopted by the brewing, metalworking, and glass and ceramics industries, demonstrating its potential for use in many industrial processes.

TEXT AND VOCABULARY EXERCISES

1. Comprehension exercises.

1.1. Which 2 statements are addressed to in the text?

1. Great Britain of the 18th century.
2. The spread of industrialization.
3. Invention of printing.
4. Social changes caused by the Industrial Revolution.
5. Economy in course of globalization.
6. Environmental pollution.
7. Invention of printing.

1.2. Answer the following questions.

1. How did the Industrial Revolution influence technology and manufacturing?
2. What has the Industrial Revolution changed into nowadays?

1.3. Find the answers in the text to the questions below.

1. When and where did the Industrial Revolution begin?
2. What changes did the society experience in the Industrial Revolution?
3. Which improvements were particularly important?
4. Which costs were brought about by the Industrial Revolution?
5. What has led to a greater land use?
6. What does modern industry require power for?
7. Why had British industries begun using the country's coal supply instead of wood?
8. Which industries was coal adopted in?
9. Which ecological problems has the Industrial Revolution brought about?
10. How have economic activities changed in many countries?

1.4. Tell if statements below are true or false according to the text. Change a sentence if it's false.

1. The Industrial Revolution began in the United States in the 20th century.
2. Today the whole world has experienced the Industrial Revolution.
3. Improvements in transportation and communication changed the world greatly.

4. Manufacturing was replaced by agriculture after the Industrial Revolution.
5. Production moved from small workshops to factories.
6. Industrialization has had its drawbacks as well.
7. Industrial processes have badly influenced the natural environments.
8. Modern industry replaces powerful machinery.
9. During the Industrial Revolution in Britain, wood was the main source of power.
10. Coal was scarce to be used in many industrial processes.

1.5. Define the processes below as either advantages or disadvantages of the Industrial Revolution.

1. Mechanization of production.
2. Inventing of complex machinery.
3. Improvements in communication and transportation.
4. Environmental pollution.
5. Extended land use.
6. Depletion of resources.
7. Rich industrialized countries and poor developing countries gap.

2. Vocabulary exercises.

2.1. Find synonyms:

A	B
to spread;	to take over;
to experience;	manufactory;
a key role;	long term;
to bring about;	to bring to;
to shift from;	to accept;
workshop;	to extend;
long run;	to cause;
loss;	to move to;
to lead;	to undergo;
to adopt;	waste.

2.2. Find antonyms:

A	B
significantly;	recession;
improvement;	uncharacteristic;
to harm;	demand;
costs;	artificial;
plentiful;	abundant;
supply;	benefits;
scarce;	deterioration;
typical;	to repair;
growth;	slightly;
natural;	poor.

2.3. Match definitions with the words below.

revolution	A fundamental radical overthrow of established organization or system.
machinery	The working parts of a machine, engine, or instrument.
workshop	A place or a building where any manufacture or handiwork is carried on.
factory	An agent or medium that contaminates pure substance.
pollutant	A collection of buildings, appropriated to the manufacture of goods.

2.4. Find words in the text which have the following definitions.

1. Intercourse by words, letters, or messages during the interchange of thoughts or opinions.
2. The action of carrying things, goods or people from one place to another.
3. The process of development of large industries as an important feature in a country or economic system.
4. The process of replacing men and animals by machinery.

2.5. Replace the <u>underlined word</u> with a word or a phrase from the text.

1. The invention of internal combustion engine <u>caused</u> dramatic changes in transportation.
2. A lot of industries benefited from the Industrial Revolution, <u>especially</u> textile industry.
3. New materials play a significant role for engineering by <u>inspiring</u> people to invent new products.
4. The importance of space exploration can be seen only after a <u>long period of time</u>.
5. This factory was closed because of great <u>expenses</u>.
6. For the construction of a new road much effort and time <u>is needed</u>.
7. The deposits of oil are <u>abundant</u> in this region.

2.6. Reorder the words to make up a sentence.

1. before, simple machines, was done, manufacturing, by hand, or, the revolution.
2. towns, was carried on, manufacturing, in guild shops, in.
3. textile and iron, industries, these, stimulate, the, innovations, helped.
4. broke, the first, threads, crude, and often, spinning machines, were, the fragile.
5. spinning, textile, revolutionized, the, jenny, the, industry.
6. iron, could, not, coal, the Industrial Revolution, developed, without, have, and.

7. other countries, of, industrialization, began, the techniques, from, Great Britain, to, to spread.

8. processes, steel, learned, up-to-date, the most, the manufacturers, for, making.

9. manufacturing, cities, centers, became, of, large-scale, industrial.

10. railroads, cities, constructed, and, to link, many roads, the growing, were, canals, industrial.

3. Text summary.

3.1. Summarize the text using the plot below.

1. The beginning of the Industrial Revolution.
2. The most important improvements.
3. Social changes caused by the Industrial Revolution.
4. The drawbacks of the Industrial Revolution.
5. Demand for energy resources.

Lesson 3

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

skilled craftsman – искусный мастер, ремесленник;
to emerge from – появляться, возникать;
statesman – государственный деятель;
locksmith – слесарь;
carpenter – плотник, столяр;
blacksmith – кузнец;
spinning jenny – прядильная машина периодического действия;
spinning frame – прядильная машина;
water frame – кольцепрядильная машина;
power loom – механический ткацкий станок;
cutting edge – передовой, современный этап;
biodegradable plastic – разлагаемая микроорганизмами пластмасса;
chlorofluorocarbons – хлорофторуглеродные соединения (CFC's);
superconductivity – сверхпроводимость;
at the forefront – на первом месте.

TEXTWORK

Read and translate the text.

Science and Technology of Great Britain

Britain has been a world leader in science and technology, and since the Industrial Revolution the nation has been a pioneer in the use of machinery. The profession of modern engineering emerged from the work of the skilled craftsmen of the 18^{th} and 19^{th} centuries.

Modern science owes much to 16^{th}-century philosopher and statesman Francis Bacon, whose theories of experimentation laid the foundation of the scientific method. Sir Isaac Newton, a scientific genius in physics and mathematics, formulated the laws of motion and gravity. Michael Faraday, another outstanding figure in British science, made important discoveries in chemistry and electricity. His work led to the creation of the electric generator. In physics, several British scientists carried on atomic research, most notably Ernest Rutherford, Sir Joseph John Thomson, and Sir John Douglas Cockcroft.

The technology of the Industrial Revolution was not developed by scientists but by practical craftsmen – locksmiths, carpenters, and blacksmiths. A key invention was a steam engine, which Scottish inventor James Watt developed in the late 18^{th} century. Steam power was then used to run various machines, including the spinning jenny, invented by James Hargreaves in the 1760s; the spinning frame, invented by Sir Richard Arkwright; and the power loom invented by Edmund Cartwright. All of these early inventions of the Industrial Revolution were first used in the textile industry, where the mass production of cotton cloth by machine was revolutionary.

In the 20th century, British science and technology continued on the cutting edge. British technology pioneered in the development of radar and jet engines. In chemistry British scientists have developed a biodegradable plastic and are working on substitutes for chlorofluorocarbons, which destroy the Earth's ozone layer. British scientists in Antarctica discovered a hole in the ozone layer in 1985. They have also made advances in the fields of astrophysics and superconductivity. Scientific engineers also are at the forefront in developing semiconductors and fiber-optic cables.

TEXT AND VOCABULARY EXERCISES

1. Comprehension exercises.

1.1. Which of the following statements are addressed to in the text?

1. Biography of Sir Isaac Newton.
2. Invention of steam engine.
3. Development of technology in Great Britain.
4. Industrial Revolution.
5. The modern stage of British science.

1.2. Answer the following questions.

1. What country has a leading role in science and technology now? Why?
2. Which changes in the world technology did the invention of steam engine cause?

1.3. Find the answers in the text to the questions below.

1. How did the profession of modern engineering appear?
2. Whom does the modern science owe?
3. Who formulated the laws of motion and gravity?
4. What research did Ernest Rutherford, Sir Joseph John Thomson, and Sir John Douglas Cockcroft carry on?
5. Who invented a steam engine?
6. What was the steam power used for?
7. Where were the early inventions of the Industrial Revolution used in?
8. When was a hole in the ozone layer discovered?
9. How do chlorofluorocarbons influence on the ozone layer?
10. What was the role of practical craftsmen in the Industrial Revolution?

1.4. Tell if statements below are true or false according to the text. Change a sentence if it's false.

1. The profession of modern engineering emerged from the work of the scientists of the 18th and 19th centuries.
2. Sir Isaac Newton formulated the laws of radioactivity.

3. Michael Faraday's research contributed to the creation of the electric generator.

4. Ernest Rutherford, Sir Joseph John Thomson, and Sir John Douglas Cockcroft worked on the creation of atomic bomb.

5. Spinning jenny, the spinning frame and other machinery were powered by steam.

6. Early inventions of the Industrial Revolution were first used in the military industry.

7. In the 20^{th} century, Great Britain has a leading role in science and technology.

8. The chlorofluorocarbons substitutes destroy the Earth's ozone layer.

9. British technology was one of the first in the development of radar and jet engines.

10. British scientists in Antarctica created a hole in the ozone layer in 1985.

1.5. How the following people contributed to the development of science and technology.

1. Isaac Newton. 2. Michael Faraday. 3. Ernest Rutherford. 4. James Watt. 5. Francis Bacon.

2. Vocabulary exercises.

2.1. Find synonyms:

A	B
to emerge from;	equipment;
machinery;	distinguished;
outstanding;	to demolish;
discovery;	growth;
various;	to appear;
skilled;	progress;
production;	different;
to destroy;	experienced;
development;	manufacture;
advance;	invention.

2.2. Match definitions with the words below.

gravity	the science of systematic knowledge of the industrial arts, especially of the more important manufactures, as spinning, weaving, metallurgy;
physics	a man of superior intellectual faculties;
technology	the tendency of a mass of matter toward a center of attraction;
invention	the science of nature, or of natural objects; that branch of science which treats of the laws and properties of matter;
genius	the act of finding out or construction of that which has not before existed.

2.3. Find words in the text which have the following definitions.

1. A craftsman whose occupation is to make or mend locks.
2. A craftsman who mixes in iron with a forge, and makes iron utensils, horseshoes.
3. A frame or machine of wood or other material, in which a weaver forms cloth out of thread.
4. A machine that transforms mechanical into electrical energy.
5. A substance composed predominantly of a synthetic organic high polymer capable of being cast or molded.

2.4. Replace the underlined word with a word or a phrase from the text.

1. Ernest Rutherford was the earliest explorer in the use of radiation in his experiments.
2. The wheel was the most important invention of ancient times.
3. The formulating of nuclear reaction made possible the creation of atomic bomb.
4. Our plant takes a first place in heavy machinery production.
5. Only experienced engineers are able to solve this problem.

2.5. Read the sentences below and fill in the gaps with the words from the box. Some words can be omitted.

and, since, though, because of, then, where, but, as

1. Britain has been a pioneer in the use of machinery … the Industrial Revolution.
2. Modern science owes much to 16th-century philosopher … statesman Francis Bacon.
3. The technology of the Industrial Revolution was not developed by scientists … by practical craftsmen.
4. Steam power was … used to run various machines.
5. These inventions of the Industrial Revolution were used in the textile industry, … the mass production of cotton cloth by machine was revolutionary.

3. Text summary.

3.1. Summarize the text using the plot below.

1. Great Britain is a leader in science and technology.
2. People who contributed to the development of British science.
3. Inventions which led to the Industrial revolution.
4. Science and technology of the 20th century.

Lesson 4

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

ability – способность, умение;
approach – подход;
approval – одобрение;
to blend – объединять;
to cause accidents – быть причиной аварий, вызывать аварии;
to concern – касаться, иметь отношение;
to consider – считать, рассматривать;
control panel – пульт управления;
to eliminate – устранять;
to employ – использовать;
engineering – техника, конструирование;
environmental – относящийся к окружающей обстановке;
to exclude – исключать;
to generate – производить;
to include – включать;
to interact with – взаимодействовать;
reference – ссылка, упоминание;
research – исследование;
safety – безопасность;
science – наука;
applied sciences – прикладные науки;
engineering science – инженерное дело, наука;
shape – форма;
to seek – искать, пытаться, стремиться;
size – размер;
to slow – замедлять, сбавлять;
to solve problems – решать проблемы;
to store – хранить;
tools – инструменты, орудие труда;
trend – направление;
utility – полезность, практичность.

TEXTWORK

Read and translate the text.

Modern Engineering

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. Hence, an engineer, essentially, is someone who makes useful or practical inventions. The first electrical engineer is considered to be William Gilbert, with his 1600 publication of De Magnete, who was the originator of the term “electricity”. The first steam engine was built in 1698 by mechanical engineer Thomas Savery. 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. The first PhD in engineering (technically, applied science and engineering) awarded in the United States went to William Gibbs at Yale University in 1863; it was also the second PhD awarded in science in the U.S.

Now engineering science is among the world's top undergraduate engineering programmes. Its mission is to prepare the students for careers at the forefront of research, teaching, design and professional practice in applied science and engineering, or for careers in other professions to which they can bring their superior knowledge of applied science and engineering to bear.

Modem Engineering includes technology, but is also concerned with development and understanding of technological systems and the products. It is also concerned with non-technological approaches. Technical engineering is the activity of transforming and transporting (1) of materials and forces of nature and (2) of energy and information, which are technical measures of utility. This statement excludes reference to value and method. To complete the understanding of modern engineering, one should identify its values, its societal and environmental objectives and its tools. 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 engineering principles.

A related field of engineering, human-factors engineering, also known as ergonomics, received wide attention in the late 1970s and the '80s 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-centered design of, among other things, the large, complicated control panels that monitor and govern nuclear reactor operations. Engineering is the design, analysis, and/or construction of works for practical purposes. One who practices engineering called an engineer.

The broad discipline of engineering encompasses a range of specialized subdisciplines that focus on the issues associated with developing a specific kind of product, or using a specific type of technology. The crucial and unique task of the engineer is to identify, understand, and interpret the constraints on a design in order to produce a successful result. It is usually not enough to build a technically successful product; it must also meet further requirements. Constraints may include available resources, physical, imaginative or technical limitations, flexibility for future modifications and additions, and other factors, such as requirements for cost, safety, marketability, and serviceability. Engineers use their knowledge of science, mathematics, and appropriate experience to find suitable solutions to a problem. Engineers typically attempt to predict how well their designs will perform to their specifications prior to full-scale production.

As with all modem scientific and technological endeavors, computers and software play an increasingly important role.

Computers are increasingly used for solving complex problems as well as for handling, storing, and generating the enormous volume of data modem engineers must work with.

TEXT AND VOCABULARY EXERCISES

1.1. Find in the text the words or phrases which mean the same as:

- инженерная наука;
- прикладные науки;
- критерии полезности;
- инженерные принципы;
- исследование процессов;
- технология;
- соответствие, точность;
- характеризуется;
- решение сложных проблем;
- принятие решений.

1.2. Find in the text the synonyms to the following words:

- task;
- manner;
- basis;
- to get ready;
- to recognize;
- new;
- qualification;
- sphere;
- to produce.

1.3. Find in the text the antonyms to the following words:

- top;
- technological;
- directly;
- efficient;
- to include;
- to complete;
- broad;
- complicated;
- understanding;
- several;
- malfunctioning;
- approval.

1.4. Find the English equivalents to the following Russian words:

1) наука:	a) since;	b) science;	c) sincere;
2) включать:	a) to include;	b) to conclude;	c) to induce;
3) исключать:	a) to exclaim;	b) to excrete;	c) to exclude;
4) реактор:	a) reactant;	b) reaction;	c) reactor;
5) широкий:	a) wide;	b) weigh;	c) wild;
6) относиться, касаться:	a) to coincide;	b) to consider;	c) to concern.

1.5. Give Russian equivalents to the following word combinations:

engineering programmes; to prepare the students for careers; professional practice; understanding of technological systems; nontechnological approaches; scientific methods; various engineering disciplines; human-factors engineering; to establish criteria for the efficient, human-centered design; solving complex problems.

1.6. Choose among the words in parentheses the one that corresponds to the text above to complete the sentences.

1. Engineering Science is among the world's top undergraduate engineering ___.
(a. contents; b. context; c. programmes)

2. Its mission is ___ the students for careers at the forefront of research, teaching, design and professional practice in applied science and engineering.
(a. to prepare; b. to make; c. to learn)

3. Modern Engineering is ___ by the broad application of systems engineering principles.

(a. defined; b. known; c. characterized)

4. Human-factors engineering, also known as ___ received wide attention in the late 1970s and the 1980s.

(a. ergonomics; b. economics; c. environment)

5. Ergonomics seeks to establish ___ for the efficient humancentered design of the large, complicated control panels that monitor and govern nuclear reactor operations.

(a. foundations; b. theories; c. criteria)

6. Among various recent trends in the engineering profession, licensing and computerization are the most ___.

(a. widespread; b. large; c. useful)

7. Computers are increasingly ___ for solving complex problems as well as for handling, storing, and generating the enormous volume of data.

(a. described; b. written; c. used)

1.7. Read the Text once more. In pairs, discuss the statements below. Say what you think about them and ask your partner if he/she agrees or disagrees with you. Use the following phrases to help you.

Agreeing	**Disagreeing politely**
I agree with you.	Yes, but don't you think … ?
Yes, that is what I think too.	True, but I think …
You are right!	I see what you mean, but …

1. Engineering science is among the world's top undergraduate engineering programmes.
2. Its mission is to prepare the students only for careers at the forefront of research, teaching, design and professional practice in applied science and engineering.
3. Modern engineering is concerned with development and understanding of technological systems and products.
4. To complete the understanding of modern engineering, one should identify its values, its societal and environmental objectives and its tools.
5. Scientific methods of engineering are applied in several fields connected to manufacture and construction.
6. The systems approach is a methodology of decision-making in design, operation or construction.
7. Human-factors engineering seeks to establish criteria for the efficient, human-centered design of the large, complicated control panels that monitor and govern nuclear reactor operations.
8. Among various recent trends in the engineering profession, licensing and computerization are the most widespread.

1.8. Fill in the gaps with the words from the box.

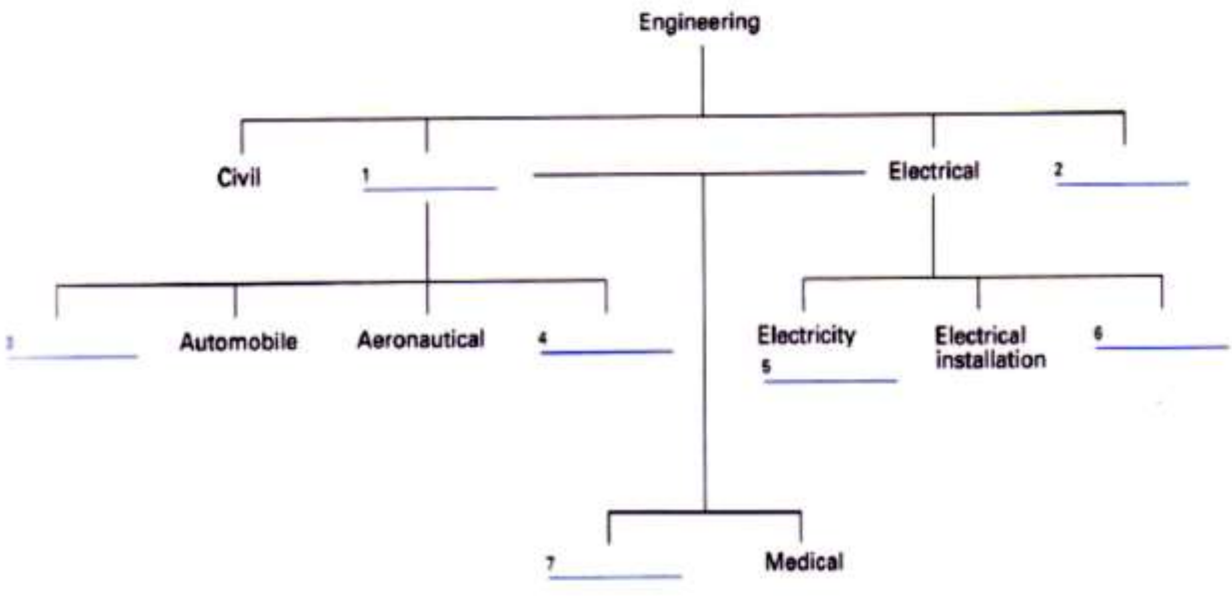
more	devices	creative	performed	smart	efficiency	result	control

Computers are part of many machines and devices, that once required continual human supervision and 1 ___. Today, computers in security systems 2 ___ in safer environment. Computers in cars improve energy 3 ___. These 4 ___ machines are designed to take over some of the basic tasks previously 5 ___ by people. With small computing 6 ___ people are able to spend more time doing what they often do best - being 7 ___. Computers can help people work 8 ___ creatively.

Read the text and complete the blanks in the diagram below using information from the text.

Engineering is largely a practical activity. It is about putting ideas into action. Civil engineering is concerned with making bridges, roads, airports, etc. Mechanical engineering deals with the design and manufacture of tools and machines. Electrical engineering is about the generation and distribution of electricity and its many applications. Electronic engineering is concerned with developing components and equipment for communications, computing, and so on.

Mechanical engineering includes marine, automobile, aeronautical, heating and ventilating, and others. Electrical engineering includes electricity generating, electrical installation, lighting, etc. Mining and medical engineering belong partly to mechanical and partly to electrical.



UNIT 3: ENGINEERING DESIGN AND MANUFACTURING

Lesson 1

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

to search for – искать;
drawing – чертёж;
by hand – вручную;
CAD – система автоматизированного проектирования (САПР);
scale drawing – чертёж в масштабе;
relative to – в сравнении, относительно;
to enlarge – увеличить;
simplified form – упрощённая форма;
referred to – называемый, именуемый;
in relation to – по отношению;
to require – требовать;
section – *зд.* разрез;
exploded view – трёхмерное, пространственное изображение;
to space out – разнести, расположить по отдельности;
visualize – отображать;
assembly – сборка;
two-dimensional elevation – двухмерный вид (спереди);
oblique projection – косая проекция;
cross-section – поперечное сечение.

TEXTWORK

Read and translate the text.

Drawings: Types and Scales

In engineering, most design information is shown on drawings. Today, drawings are generally not drawn by hand. They are produced on computer, using CAD (computer-aided design) systems.

A key factor on a drawing is the scale – that is, the size of items on the drawing in relation to their real size. When all the items on a drawing are shown relative to their real size, the drawing is drawn to scale, and can be called a scale drawing. An example of a scale is 1:10 (one to ten). At 1:10, an object with a length of 100 mm in real life would measure 10 mm on the drawing.

Most engineering designs consist of a set of drawings (a number of related drawings):

• General arrangement (GA) drawings show whole devices or structures, using a small scale. This means objects on the drawing are small, relative to their real size (for example, a 1:100 drawing of an entire building).

• Detail drawings show parts in detail, using a large scale, such as 1:5 or 1:2. Small parts are sometimes shown in a detail as actual size (1:1), or can be enlarged to bigger than actual size (for example, 2:1).

For electrical circuits, and pipe and duct networks, it is helpful to show designs in a simplified form. In this case, schematic drawings (often referred to as schematics) are used. An everyday example is the map of a train network.

Notes: *When written, drawing is often abbreviated to* ***dwg****.*
CAD *is pronounced as a word: /kæd/.*

Types of views used on drawings

Technicians are discussing different views shown on drawings (looking at components from above, from the side, etc.), as they search for the information they require.

"We need a view from above showing the general arrangement of all of the roof panels – a plan of the whole area."

"According to this list, there are elevations of all four sides of the machine on drawing 2B. So one of those should show the front of the machine."

"There should be a section through the pipe, showing the valve inside, on drawing 36."

"We need an exploded view of the mechanism, showing the components spaced out."

"It's hard "to visualize this assembly, based on two-dimensional elevations and sections. It would be clearer if we had a three dimensional-view, as either an oblique projection or an isometric projection.

Notes: In non-technical, everyday English, engineering drawings are often called plans.

Section is the short form of cross-section, and is commonly used in technical contexts.

Two-dimensional and three-dimensional are often shortened to 2D and 3D.

TEXT AND VOCABULARY EXERCISES

1.1. Complete the sentences using words from the text.

1. Enlarged drawings show components larger than their …… …… .
2. For engineering drawings, 1:5 is a commonly used …… .
3. Whole machines or structures are shown on …… …… drawings.
4. Electrical drawings don't usually show sizes. They're shown as …… .
5. A …… of drawings for a large project can consist of hundreds of pages.
6. Most drawings are produced on computers, using …… software.

1.2. Match the descriptions (1-6) with the names of views used on drawings (a-f).

1) a 2D view of the side of an object;	a) a plan;
2) a 2D view inside an object, as if it is cut through;	b) a section;
3) a 2D view, looking down on top of an object;	c) an isometric projection;
4) a 3D view, showing an assembly taken to pieces;	d) an oblique projection;
5) a 3D view, with the 2D face of the object at the front ;	e) an exploded view;
6) a 3D view, with a corner of the object at the front;	f) an elevation.

1.3. Write the full forms, in words, of the abbreviations and shortened terms below.

1. GA.
2. CAD.
3. dwg.
4. 3D.
5. section.
6. 1:50.

1.4. Complete the sentences, taken from conversations about drawings, using the words and abbreviations in the box.

3D	detail	elevation	GA	plan	scale	schematic	section

1. We need a … through the bridge, showing the profile of the deck.
2. The only drawing we have is the …, which is 1:100, so it obviously doesn't show things in detail.
3. On drawing 12, there's a large … of the entire top deck of the ship.
4. This is the … showing the front face of the tower.
5. Modern CAD systems can produce … drawings that look almost as realistic as photographs.
6. We don't need dimensions and positions at this stage. We just need a … showing how many branches come off the main supply pipe.
7. We don't have a proper drawing. We've just got a rough sketch, which is not to … .
8. The fixings aren't shown on the 1:50 general arrangement. But there's a … at 1:5, on drawing 42.

Lesson 2

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

manufacturing – производство;
raw materials – сырьё;
to accomplish – выполнять, завершать;
assembly – сборка;
extraction – выделение, извлечение;
alteration – изменение;
molding – формовка, модификация;
lumber – деревоматериалы;
to permit – позволять;
to adhere – придерживаться;
to require – требовать;
clay pot – глиняный горшок;
to establish – устанавливать, учреждать;
trade – торговля;
tools – инструменты;
durable – долговечный, предназначенный для длительного пользования;
deterioration – изнашивание;
life span – жизненный отрезок.

TEXTWORK

Read and translate the text.

Manufacturing Process

Manufacturing means producing goods that are necessary for modern life from raw materials. The word manufacture comes from the Latin *manus* (hand) and *facere* (to make). Originally manufacturing was accomplished by hand, but most of today's modern manufacturing operations are highly mechanized and automated.

There are three main processes involved in virtually all manufacturing: assembly, extraction, and alteration. Assembly is the combination of parts to make a product. For example, an airplane is assembled when the manufacturer puts together the engines, wings, and fuselage. Extraction is the process of removing one or more components from raw materials, such as obtaining gasoline from crude oil. Alteration is modifying or molding raw materials into a final product – for example, sawing trees into lumber.

Science and engineering are required to develop new products and to create new manufacturing methods, but there are other factors involved in the manufacturing process. Legal matters, such as obtaining operating permits and meeting industrial safety standards, must be adhered to. Manufacturing has existed as long as civilizations have required goods: bricks to build the Mesopotamian city of Erech, clay pots to store grain in ancient Greece, or bronze weapons for the Roman Empire. In the Middle Ages, silk factories operated in Syria, and textile mills were established in Italy, Belgium, France, and England. New routes discovered from Europe to the Far East and to the New World during the Renaissance stimulated demand for manufactured goods to trade. Factories were built to produce gunpowder, clothing, cast iron, and paper. The manufacturing of these goods was primarily done by hand labor, simple tools, and, rarely, by machines powered by water.

Manufacturing processes can produce either durable or nondurable goods. Durable goods are products that exist for long periods of time without significant deterioration, such as automobiles, airplanes, and refrigerators. Nondurable goods are items that have a comparatively limited life span, such as clothing, food, and paper.

TEXT AND VOCABULARY EXERCISES

1. Comprehension exercises.

1.1. Which 2 statements are addressed to in the text?

1. Assembly of an airplane.
2. Main manufacturing processes.
3. Industrial safety standards.
4. History of Mesopotamia.
5. The role of manufacturing for different civilizations.
6. Hand labor.

1.2. Answer the following questions.

1. Why should manufacturing process be studied by engineers?
2. What is the role of science and engineering in manufacturing process? Give examples, please.

1.3. Find the answers in the text to the questions below.

1. What words does the word *manufacture* come from?
2. Which processes are involved in manufacturing?
3. What is assembly?
4. What process is used to obtain gasoline from crude oil?
5. How long has manufacturing existed?
6. What is required to develop new products and to create new manufacturing methods?
7. How was the manufacturing of goods done in ancient times?
8. What kinds are the most of manufactured goods divided into?
9. What goods are called durable? Give the examples, please.
10. What goods are called nondurable? Give the examples, please.

1.4. Tell if statements below are true or false according to the text. Change a sentence if it’s false.

1. Modern manufacturing operations are mostly performed by machines.
2. Extraction is the combination of parts to make a product.
3. Gasoline is obtained from crude oil by alteration.

4. Alteration is the modification of form but not substance of raw material.
5. Industrial safety standards are the part of manufacturing process.
6. Manufacturing appeared in ancient Greece.
7. New routes from Europe to the Far East stimulated the trade.
8. Hand labor was widely used in manufacturing process in ancient times.
9. Nondurable goods last for a long time.
10. Buildings, bridges, roads are the examples of durable products.

1.5. Which manufacturing processes are the examples below?

1. Manufacturing of clothing.
2. Steel production.
3. Manufacturing of machine tools.
4. Paper production.
5. Making of plastic bottles.
6. Fiber processing.
7. Manufacturing of household appliances.

2. Vocabulary exercises.

2.1. Find synonyms:

A	B
necessary;	to satisfy requirements;
come from;	continual;
put together;	to keep;
molding;	factory;
meet standards;	durability;
exist;	to originate;
to store;	to be;
durable;	to assemble;
life span;	essential;
mill;	shaping.

2.2. Find antonyms:

A	B
final;	refinement;
simple;	often;
deterioration;	unrestricted;
rare;	ready-made product;
limited;	initial;
raw material;	complex.

2.3. Match definitions with the words below.

assembly	Any product that comes from mines, farms, forests, before it is separated for use in factories, mills and similar places.
manufacturing	The process of removing components from raw materials.
extraction	The process of by modifying raw material into a final product, generally by changing the form.
raw material	The process of gathering and combining different parts together in order to make a product.
alteration	The process of making articles by hand or machine, especially in large quantities.

2.4. Find names of materials and substances in the text which have the following definitions.

1. A highly volatile mixture of fluid hydrocarbons, obtained from petroleum.
2. Timber sawed or split into the form of beams, joists, boards, planks, hoops.
3. A block or clay tempered with water, sand, molded into a regular form, burnt in a kiln.
4. A soft earth, which is plastic, or may be molded with the hands, consisting of hydrous silicate of aluminum.
5. The fine, soft thread produced by various species of caterpillars in forming the cocoons within which the worm is inclosed.
6. A black, granular, explosive substance, consisting of an intimate mechanical mixture of niter, charcoal, and sulphur.
7. A hard form of iron which contains carbon and silicon and is used to make automobile engine blocks and the like.
8. A substance in the form of thin sheets or leaves for writing or printing on, or to be used in wrapping. It is made of rags, straw, bark, wood, or other fibrous material, which is first reduced to pulp, then molded, pressed, and dried.
9. Petroleum in its natural state, as obtained from the ground before refining.

2.5. Replace the <u>underlined word</u> with a word or a phrase from the text.

1. Manufacturing process is becoming <u>extremely</u> computerized at present.
2. Knowledge and skills <u>are needed</u> to create new methods of production.
3. It is quite difficult <u>to comply with requirements</u> they demand.
4. <u>Textile factories</u> make up a significant part of Belarusian industry.
5. This model of the computer has very short <u>durability</u>.

2.6. Reorder the words to make up a sentence.

1. design, manufacturers, that, will be, must, easy and safe, products, to use.
2. the, designs, the public's interest, attract, new.

3. search for, manufactured, that, engineers, new materials, will improve, items.

4. new uses, not only, new products, research, old ones, but also, finds, develops, for.

5. manufacturing, machinery, activity, is, food processing, the most important, the production of.

6. engineers, provides such as, a manufacturing company, people, factory workers, to many, and, jobs.

7. is, the leading, in the country, manufacturing industry, metalworking.

8. steel, iron, most, manufacturing, is used in.

9. manufacturing, many of, Japan, the raw materials, for, must import.

10. petrochemical, the various compounds of, is based on, carbon, hydrogen, and, production.

3. Text summary.

3.1. Summarize the text using the plot below.

1. The origin of manufacturing.
2. The manufacturing processes.
3. The role of science and engineering.
4. Production of durable and nondurable goods.

Lesson 3

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

human engineering – эргономическое проектирование, организация труда;
safety – безопасность;
to draw on – обращаться к чему-л.;
to adapt – приспосабливать;
limitations – ограничения;
capacities – возможности;
armed with – вооружённый;
ranging from … to – от … до;
flight deck – кабина пилота;
to blend – соединять, смешивать, сочетать;
accurately – точно;
performance – производительность;
to take advantage of – извлекать пользу;
primary goal – главная цель;
prevention – предотвращение, предупреждение, профилактика;
to eliminate – устранять;
assembly line –сборочный конвейер;
twisting – изгибание;
reaching – вытягивание;
bending – нагибание;
to accommodate – приспосабливать;
to lean – наклоняться;
to overextend – перенапрягать;
to ensure – гарантировать, обеспечивать;
to arrange – располагать, организовывать;
physical and mental fatigue – физическая и умственная усталость;
to reduce accuracy – снизить точность;
to cause accidents – приводить к авариям, несчастным случаям.

TEXTWORK

Read and translate the text below.

Ergonomics

Ergonomics, also known as human engineering or human factors engineering, is the science of designing machines, products, and systems to maximize the safety, comfort, and efficiency of the people who use them. Ergonomists draw on the principles of industrial engineering, psychology, anthropometry (the science of human measurement), and biomechanics (the study of muscular activity) to adapt the design of products and workplaces to people's sizes and shapes and their physical strengths and limitations. Ergonomists also consider the speed with which humans react and how they process information, and their capacities for dealing with psychological factors, such as stress or isolation. Armed with this complete picture of how humans interact with their environment, ergonomists develop the best possible design for products and systems, ranging from the handle of a toothbrush to the flight deck of the space shuttle. Ergonomists view people and the objects they use as one unit, and ergonomic design blends the best abilities of people and machines. Humans are not as strong as machines, nor can they calculate as quickly and accurately as computers.

Unlike machines, humans need to sleep, and they are subject to illness, accidents, or making mistakes when working without adequate rest. But machines are also limited – cars cannot repair themselves, computers do not speak or hear as well as people do, and machines cannot adapt to unexpected situations as well as humans. An ergonomically designed system provides optimum performance because it takes advantage of the strengths and weaknesses of both its human and machine components. One of the primary goals of ergonomics is prevention of workplace illness and accidents. Ergonomists work to eliminate these problems by designing workplaces, such as offices or assembly lines, with injury prevention in mind. They position tools and machinery to be accessible without twisting, reaching, or bending. They design adjustable workbenches, desks, and chairs to comfortably accommodate workers of many different sizes, preventing the need to continuously lean or overextend the arms.

Ergonomists also determine and design safe workplace environmental conditions, such as correct temperature, lighting, noise, and ventilation to ensure that workers perform under optimal conditions. Ergonomists also seek to increase worker efficiency and productivity when designing workspaces. They place those pieces of equipment used most frequently in closest proximity to the worker and arrange systems in ways that are convenient and easy to use.

Well-designed workspaces ensure that workers perform their jobs in optimal comfort, without experiencing the unnecessary physical and mental fatigue that can slow work performance, reduce accuracy, or cause accidents.

TEXT AND VOCABULARY EXERCISES

1.1. Find in the text the words or phrases which mean the same as:

- наука проектирования;
- обрабатывать информацию;
- точно;
- приспособлять, адаптировать;
- окружающая среда;
- конвейерные линии;
- совершать ошибку;
- хорошо спроектированные рабочие места.

1.2. Find in the text the synonyms to the following words:

- to employ;
- to be concerned with;
- to place;
- aims;
- fundamentals;
- to define;
- to view;
- to mix;
- parts.

1.3. Find in the text the antonyms to the following words:

■ to minimize;	■ incomplete;	■ like;
■ weak;	■ with;	■ unsafe;
■ seldom;	■ badly-designed;	■ necessary.

1.4. Choose among the words in parentheses the one that corresponds to the text above to complete the sentences.

1. Ergonomics is the science of designing machines, products and systems to maximize the safety, comfort and ___ of the people who use them.

(a. importance; b. effect; c. efficiency)

2. Ergonomists ___ the best possible design for products and systems.

(a. develop; b. imagine; c. create)

3. Ergonomists view people and the objects they use as one unit, and ergonomic design blends the best ___ of people and machines.

(a. abilities; b. skills; c. characteristics)

4. ___ machines, humans need to sleep, and they are subject to illness, accidents or making mistakes when working without adequate rest.

(a. like; b. unlike; c. as)

5. Machines cannot ___to unexpected situations as well as humans.

(a. adapt; b. regulate; c. correspond)

6. One of the ___ goals of ergonomics is prevention of work place illness and accidents.

(a. main; b. important; c. primary)

7. They ___ tools and machinery to be accessible without twisting, reaching, or bending.

(a. make; b. position; c. design)

8. Ergonomists determine and design safe workplace ___ conditions, such as correct temperature, lighting, noise and ventilation.

(a. house; b. place; c. environmental)

9. Well-designed workspaces ensure that workers perform their jobs in optimal ___.

(a. convenience; b. comfort; c. atmosphere)

1.4. Read the text once more. In pairs, discuss the statements below. Say what you think about them and ask your partner if he/she agrees or disagrees with you. Use the following phrases to help you.

Agreeing	**Disagreeing politely**
I agree with you.	Yes, but don’t you think … ?
Yes, that is what I think too.	True, but I think …
You are right!	I see what you mean, but …

1. Ergonomics is an applied science.
2. Ergonomists draw on principles of industrial engineering, psychology, anthropometry and biomechanics to adapt the products and workplaces to people's sizes and shapes and their physical strengths and limitations.
3. Ergonomists also consider the speed with which humans react and how they process information, and their capacities for dealing with psychological factors.
4. Humans are not as strong as machines, nor can they calculate as quickly and accurately as computers.
5. Machines are also limited.
6. Ergonomists seek to increase worker efficiency and productivity when designing workplaces.
7. Ergonomists place those pieces of equipment used most frequently in closest proximity to the worker and arrange systems in ways that are convenient and easy to use.

1.5. Give your own ideas concerning your understanding of ergonomics. Do it in written form (8-10 sentences).

2. Follow-up Activity.

2.1. What is repetitive strain injury (RSI)? What is the equivalent phrase in your language?

2.2. Read the text and match the headings (A-D) with the paragraphs (1-3). There is one extra heading that you do not need to use.

A. Advice for computer workers.
B. Advice for factory' workers.
C. General advice.
D. What is RSI?

Repetitive Strain Injury (RSI)

Any person who repeats the same movement a lot of times can develop repetitive strain injury. Factory workers, computer operators, sports people, and musicians are at the most **risk** because their jobs involve making the same movement thousands of times. The **symptoms** of RSI include: pain and/or burning in the damaged area, difficulty in moving, and loss of feeling.

It is difficult to **cure** RSI but you can avoid it before it starts. To **prevent** RSI, workers at risk should:

• take regular breaks from their work to stretch and move about;
• learn to sit and move correctly so they use their bodies naturally.

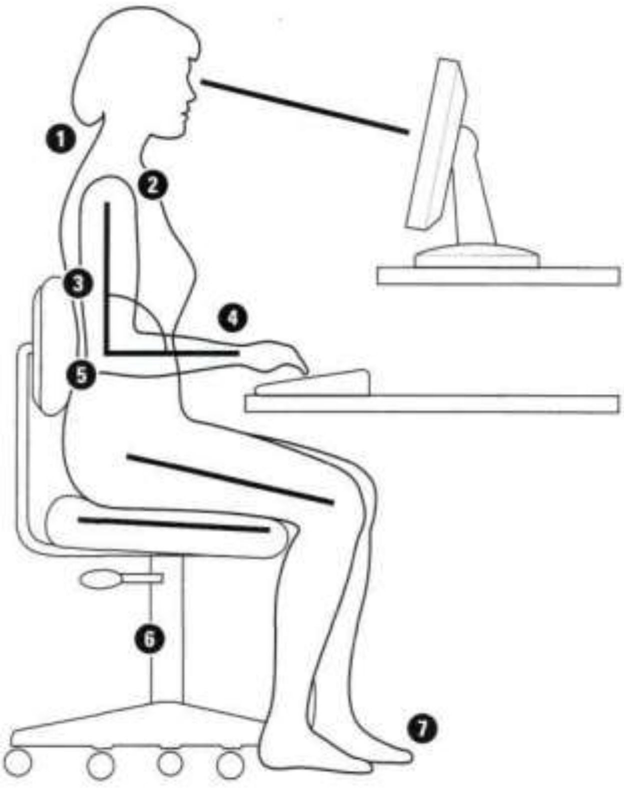
People who use computers for a long time have a high risk of developing RSI. Here are some basic rules for working safely at a computer:

• take regular breaks to stretch and relax;

• move the screen to eye level or a little bit lower;
• don't hold the mouse for too long or too tightly;
• sit with your back **relaxed**, shoulders down and your neck straight;
• keep your wrists relaxed, your elbows at about 90 degrees and the lower parts of your arms parallel to the desktop;
• use **adjustable** chair;
• keep your feet flat on the floor.

2.3. Match the bold words in the text with the meanings (1-6) below.
1) a danger;
2) can be moved into different shapes or positions;
3) signs of an illness;
4) stop something happening;
5) to make an illness better;
6) without tension or strain.

2.4. Look at the picture and put the labels (a-g) below in the correct place.
a) elbows at 90 degrees;
b) feet flat on the floor;
c) head and neck straight and relaxed;
d) lower arm horizontal;
e) shoulders down;
f) upper arm vertical;
g) use an adjustable chair.



UNIT 4: COMPUTER USE AND COMPUTER ENGINEERING

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

advance – прогресс;
to apply – применять;
available – доступный;
chip – чип , микросхема;
circuit – схема;
to convert – преобразовывать;
digital – цифровой;
keyboard – клавиатура;
to maintain – поддержать, обслуживать;
modem – модем;
to predefine – предопределить;
programming languages – языки программирования;
endeavour – попытка, стремление;
to retain – сохранить;
to encompass – охватывать;
hardware – аппаратные средства;
to install – устанавливать;
to integrate – объединять обеспечение;
to implement – выполнять, осуществлять;
software – программное обеспечение;
time-consuming – требующий больших затрат времени;
user – пользователь;
utility programme – сервисная программа

TEXTWORK

Read the text to learn about computer use and computer engineering. The words and word combinations below will help you to understand the text; memorize these words.

CAD – computer-aided design – автоматизированное проектирование.

VLSI – very large-scale integration – интеграция сверхвысокого уровня.

CNC – computer numerical control – компьютерное числовое программное управление.

FEA – finite-element analysis – анализ с использованием метода конечных элементов.

PCB – Printed Circuit Board – печатная плата.

Circuit board – монтажная плата.

COBOL – common business-oriented language – язык программирования КОБОЛ.

FORTRAN – ФОРТРАН (алгоритмический язык).

C++, C – языки программирования.

Java – язык Java – машинонезависимый объектно-ориентированный язык, разработанный фирмой Sun Microsystems для создания распределённых прикладных Web-систем.

Intranet – 1) технология создания корпоративной локальной сети повышенной надёжности с ограниченным доступом, использующей сетевые стандарты и сетевые программно-аппаратные средства, аналогичные Internet; 2) внутрисетевой.

Customization – подгон под потребителя (приспособление товара к конкретным требованиям клиентов; выполнение по индивидуальному заказу; подгонка, оформление в соответствии с требованиями заказчика).

Read and translate the text below.

Computer Use and Computer Engineering

As with all modem scientific and technological endeavours, computers and software play an increasingly important role. Numerical methods and simulations can help predict design performance more accurately than previous approximations.

Using computer-aided design (CAD) software, engineers are able to create more easily drawings and models of their designs. Computer models of designs can be checked for flaws without having to make expensive and time-consuming prototypes. The computer can automatically translate some models to instructions suitable for automatic machinery (e.g., CNC) to fabricate a design.

The computer also allows increased reuse of previously developed designs, by presenting an engineer with a library of predefined parts ready to be used in designs. Of late, the use of finite element method analysis (FEM analysis or FEA) software to study stress, temperature, flow as well as electromagnetic fields has gained importance. In addition, a variety of software is available to analyze dynamic systems. Electronics engineers make use of a variety of circuit schematics software to aid in the creation of circuit designs that perform an electronic task when used for a printed circuit board (PCB) or a computer chip.

Computer Engineering is a discipline encompassing electronic engineering and computer science. This hybrid of electronic engineering and computer science allows the computer engineer to work on both software and hardware, and to integrate the two. Computer engineers are involved in all aspects of computing, from the design of individual microprocessors, personal computers, and supercomputers, to the integration of computer systems into other kinds of systems, e.g. a motor vehicle has a number of subsystems that are computer and digitally oriented. Electronic equipment today relies very heavily on computer technology and so electronic engineers and computer engineers may work together to design and manufacture electronic equipment which requires both hardware and software design. Common computer engineering tasks include writing embedded software for real-time microcontrollers, designing VLSI chips, working with analog sensors, designing mixed signal circuit boards, and designing operating systems.

The high demand for engineers who are able to design and manage all forms of computer systems in industry has led to tertiary institutions around the world to implement a new bachelor’s degree generally called computer engineering. Both computer engineering and electronic engineering programmes include analog and digital circuit design into their curriculums. Computer hardware engineers research, design, develop, test, and oversee the installation of computer hardware and supervise its manufacture and installation. Hardware refers to computer chips, circuit boards, computer systems, and related equipment such as keyboards, modems, and printers.

Computer software engineers design and develop the software systems that control computers. The work of computer hardware engineers is very similar to that of electronics engineers, but, unlike electronics engineers, computer hardware engineers work exclusively with computers and computer-related equipment. The rapid advances in computer technology are largely a result of the research, development, and design efforts of computer hardware engineers.

The explosive impact of computers and information technology on our everyday lives has generated a need to design and develop new computer software systems and to incorporate new technologies into a rapidly growing range of applications. The tasks performed by workers known as computer software engineers evolve quickly, reflecting new areas of specialization or changes in technology, as well as the preferences and practices of employers.

Computer software engineers apply the principles and techniques of computer science, engineering, and mathematical analysis to the design, development, testing, and evaluation of the software and systems that enable computers to perform their many applications.

Software engineers working in applications or systems development analyze users' needs and design, construct, test, and maintain computer applications software or systems. Software engineers can be involved in the design and development of many types of software, including software for operating systems and network distribution, and compilers, which convert programmes for execution on a computer. In programming, or coding, software engineers instruct a computer, line by line, how to perform a function. They also solve technical problems that arise. Software engineers must possess strong programming skills, but are more concerned with developing algorithms and analyzing and solving programming problems than with actually writing code.

Computer applications software engineers analyze users' needs and design, construct, and maintain general computer applications software or specialized utility programmes. These workers use different programming languages, depending on the purpose of the programme. The programming languages most often used are C, C++, and Java, with FORTRAN and COBOL used less commonly. Some software engineers develop both packaged systems and systems software or create customized applications.

Computer systems software engineers coordinate the construction and maintenance of a company's computer systems and plan their future growth. Working with the company, they coordinate each department's computer needs - ordering, inventory, billing, and payroll recordkeeping, for example – and make suggestions about its technical direction. They also might set up the company's intranets-networks that link computers within the organization and ease communication among the various departments. Systems software engineers work for companies that configure, implement, and install complete computer systems. These workers may be members of the marketing or sales staff, serving as the primary technical resource for sales workers and customers. They also may be involved in product sales and in providing their customers with continuing technical support. Since the selling of complex computer systems often requires substantial customization for the purchaser's organization, software engineers help to explain the requirements necessary for installing and operating the new system in the purchaser's computing environment. In addition, systems software engineers are responsible for ensuring security across the systems they are configuring.

Computer software engineers often work as part of a team that designs new hardware, software, and systems. A core team may comprise engineering, marketing, manufacturing, and design people, who work together until the product is released.

Notes on the text:
payroll recordkeeping – ведение записей платежной ведомости;
billing – составление счетов, накладной.

TEXT AND VOCABULARY EXERCISES

1.1. Find in the text the words or phrases which mean the same as:

- ■ повторно использовать;
- ■ вычислительная техника;
- ■ программное обеспечение;
- ■ потребности пользователей;
- ■ аппаратное обеспечение;
- ■ объединять;
- ■ предопределенный;
- ■ подсистемы;
- ■ специализация;
- ■ язык программирования;
- ■ обслуживать;
- ■ преобразовывать.

1.2. Find in the text the synonyms to the following words:

- ■ to attempt, to try;
- ■ to perform;
- ■ to carry out, to execute;
- ■ sketch;
- ■ to carry into effect;
- ■ to change;
- ■ to fulfil, to complete.

1.3. Give Russian equivalents to the following word combinations.

Scientific and technological endeavours; numerical methods; time-consuming prototypes; to be suitable; to reuse previously developed designs; digitally oriented; electronic equipment; to rely on; hardware and software design; high demand; analog and digital circuit design; rapid advances in computer technology; users' needs; to install complete computer systems; to design new hardware.

1.4. Match each word in A with the correct Russian equivalent in B.

A		B	
	1. accurately;		a. создавать;
	2. suitable;		b. отнимающий много времени;
	3. reuse;		c. изготовлять ;

4. to be used;	d. точно;
5. to fabricate;	e. сеть;
6. network;	f. преобразовывать;
7. to create;	g. поддержка;
8. commonly;	h. обычно;
9. time-consuming;	i. использоваться;
10. to convert;	j. повторное использование;
11. support;	k. подходящий.

1.5. Choose among the words in parentheses the one that corresponds to the text above to complete the sentences.

1. As with all modern scientific and technological endeavours, computers and software play an increasingly ___ role.

(a. negligible; b. insignificant; c. important)

2. Numerical methods and simulations can help predict design performance more accurately than ___approximations.

(a. previous; b. future; c. recent)

3. Using computer-aided design software, engineers are ___ create more easily drawings and models of their designs.

(a. able to; b. allow to; c. have to)

4. The use of finite element method analysis software to study stress, temperature, flow as well as electromagnetic fields ___ importance.

(a. will gain; b. has gained; c. gained)

5. Computer Engineering ___ a discipline encompassing electronic engineering and computer science.

(a. was; b. are; c. is)

6. Electronic ___ today relies very heavily on computer technology.

(a. equipment; b. production; c. goods)

7. The rapid ___ in computer technology are largely a result of the research, development, and design efforts of computer hardware engineers.

(a. backwardness; b. development; c. advances)

1.6. Fill in the gaps with the words from the box.

store	camcorders	drives	computer	to tape	power

Nearly every desktop 1 ___ and server in use today contains one or more hard-disk 2 ___. Every mainframe and supercomputer is normally connected 3 ___ hundreds of them. You can even find VCR-type (VCR – Video Cassette Recorder – кассетный видеомагнитофон) devices and 4 ___ that use hard disks instead of 5 ____. These billions of hard disks do one thing well - they 6 ___ changing digital information in a relatively permanent form. They give computers the ability to remember things when the 7 ___ goes out.

UNIT 5: ELECTRICITY

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

cell – батарея;
solar cell – солнечная батарея;
charge – заряд;
circuit – цепь;
electrical circuit – электрическая цепь;
coil – катушка;
to conduct – проводить;
current – ток;
alternating current – переменный ток;
direct current – постоянный ток;
device – устройство;
frequency – частота;
insulator – изолятор;
to generate – производить;
level – уровень;
to measure – измерять;
power – мощность, энергия;
to push – выталкивать;
repulsion – отталкивание;
pressure – давление;
resistance – сопротивление;
source – источник;
source of electricity – источник электричества;
to transmit – передавать;
voltage – напряжение;
wire – провод.

TEXTWORK

Read the text below to learn about electricity, conductors and electrical circuits.

What is Electricity?

Electricity completely surrounds us. For most of us modern life would be impossible without it. Here are just a few examples:

■ Throughout your house, you probably find electric outlets where you can plug in all sorts of electrical appliances.

■ Most portable devices contain batteries, which produce varying amounts of electricity depending on their size.

■ During a thunderstorm, there are huge bolts of electricity called lightning that shoot down from the sky.

■ On a much smaller scale, you can get a shock from static electricity on dry winter days.

■ It is easy to create electricity from sunlight using a solar cell; or you can create electricity from the chemical energy in hydrogen and oxygen using a fuel cell.

So what is this mysterious stuff that we call electricity? Where does it come from, and why is it able to do so many different things? The electricity that we get from power outlets and batteries can power all different kinds of devices. The fact is that electricity can be used in a thousand different ways. For example:

■ Electric motors turn electricity into motion.
■ Light bulbs, fluorescent lamps and LEDs turn electricity into light.
■ Computers turn electricity into information.
■ Telephones turn electricity into communication.
■ TVs turn electricity into moving pictures.
■ Speakers turn electricity into sound waves.
■ Stun guns turn electricity into pain.
■ Toasters, hair dryers and space heaters turn electricity into heat.
■ Radios turn electricity into electromagnetic waves that can travel millions of miles.
■ X-rays machines turn electricity into X-rays.

It is hard to imagine modem people living without electricity. In electricity's absence, we end up reverting back to fireplaces for heat, wood-fired stoves for cooking, candles for light and the slide rules for computation. To talk over long distances we are left with smoke signals and postcards. Electricity starts with electrons. You know that every atom contains one or more electrons; you also know that electrons have a negative charge. The electrons are tightly bound to the atoms. Wood, glass, plastic, ceramic, air, cotton ... These are all examples of materials in which electrons stick with their atoms.

Because the electrons don't move, these materials cannot conduct electricity very well, if at all. These materials are electrical insulators. But most metals have electrons that can detach from their atoms and move around. These are called free electrons. Gold, silver, copper, aluminum, iron, etc., all have free electrons. The loose electrons make it easy for electricity to flow through these materials, so they are known as electrical conductors. They conduct electricity.

The moving electrons transmit electrical energy from one point to another. Electricity needs a conductor in order to move. There also has to be something to make the electricity flow from one point to another through the conductor. One way to get electricity flowing is to use a generator. A generator uses a magnet to get electrons moving.

There is a definite link between electricity and magnetism. If you allow electrons to move through a wire, they will create a magnetic field around the wire. Similarly, if you move a magnet near a wire, the magnetic field will cause electrons in the wire to move. A generator is a simple device that moves a magnet near a wire to create a steady flow of electrons.

One simple way to think about a generator is to imagine it acting like a pump pushing water along. Instead of pushing water, however, a generator uses a magnet to push electrons along. This is a slight oversimplification, but it is nonetheless a very useful analogy. There are two things that a water pump can do with water:

■ A water pump moves a certain number of water molecules.
■ A water pump applies a certain amount of pressure to the water molecules.

In the same way, the magnet in a generator can:

■ push a certain number of electrons along

■ apply a certain amount of “pressure” to the electrons. In an electrical circuit, the number of electrons that are moving is called the amperage or the current, and it is measured in amps. The “pressure” pushing the electrons along is called the voltage and is measured in volts. So you might hear someone say, “If you spin this generator at 1,000 rpm, it can produce 1 amp at 6 volts”. One amp is the number of electrons moving (1 amp physically means that 6.24 x 1018 electrons move through a wire every second), and the voltage is the amount of pressure behind those electrons. Whether you are using a battery, a fuel cell or a solar cell to produce electricity, there are three things that are always the same:

■ The source of electricity will have two terminals: a positive terminal and a negative terminal.

■ The source of electricity (whether it is a generator, battery, etc.) will want to push electrons out of its negative terminal at a certain voltage.

■ The electrons will need to flow from the negative terminal to the positive terminal through a copper wire or some other conductor. When there is a path that goes from the negative to the positive terminal, you have a circuit, and electrons can flow through the wire.

■ Electrical circuits can get quite complex. But at the simplest level, you always have the source of electricity (a battery, etc.), a load (a light bulb, motor, etc.), and two wires to carry electricity between the battery and the load. Electrons move from the source, through the load and back to the source.

Moving electrons have energy. As the electrons move from one point to another, they can do work. In an incandescent light, for example, the energy of the electrons is used to create heat, and the heat in turn creates light. In an electric motor, the energy in the electrons creates a magnetic field, and this field can interact with other magnets (through magnetic attraction and repulsion) to create motion. Each electrical appliance harnesses the energy of electrons in some way to create a useful side effect.

Notes on the text:

LED – light-emitting diode – светодиод, светоизлучающий диод, СИД.

TEXT AND VOCABULARY EXERCISES

1.1. Find in the text the words or phrases which mean the same as:

■ электрические приборы;
■ меньший масштаб;
■ отсутствие электричества;
■ электрические изоляторы;
■ связь между ...;
■ сила тока;
■ портативные устройства;
■ солнечная батарея;
■ отрицательный заряд;
■ электрические проводники;
■ воображать;
■ напряжение.

1.2. Compose your own sentences with each English equivalent of the words and phrases given in Exercise 1.1. Compare your variants with the sentences of your partner.

1.3. Find in the text the synonyms to the following words:

■ absolutely;	■ to produce;	■ various;
■ contemporary;	■ to return;	■ to comprise;
■ easy;	■ helpful;	■ mobile.

1.4. Find in the text the antonyms to the following words:

■ to destroy;
■ ancient;
■ presence;
■ positive;
■ complex;
■ negative.

1.5. Give Russian equivalents to the following word combinations.

Electric outlets; electrical appliances; static electricity; solar cell; chemical energy; sound waves; hair dryer; space heater; negative charge; electrical conductor; magnetic field; water pump; electrical circuit; to create heat.

1.6. Choose among the words in parentheses the one that corresponds to the text above to complete the sentences.

1. Throughout your house, you probably find __outlets where you can plug in all sorts of electrical appliances.

(a. electric; b. electricity; c. electrical)

2. It is easy to create electricity from sunlight __ a solar cell.

(a. utilizing; b. using; c. exercising)

3. Electric motors turn electricity in to __.

(a. motion; b. movement; c. traffic)

4. It is __ to imagine modem people living without electricity.

(a. easy; b. hard; c. possible)

5. There is a definite link __ electricity and magnetism.

(a. in; b. within; c. between)

6. The electricity that we get from power outlets and batteries __ power all different kinds of devices.

(a. can; b. may; c. must)

7. A generator is a simple __ that moves a magnet near a wire to create a steady flow of electrons.

(a. set; b. device; c. apparatus)

1.7. Read the text once more. In pairs, discuss the statements below. Say what you think about them and ask your partner if he/she agrees or disagrees with you. Use the following phrases to help you.

Agreeing	**Disagreeing politely**
I agree with you.	Yes, but don't you think … ?
Yes, that is what I think too.	True, but I think …
You are right!	I see what you mean, but …

1. Only for some of us modem life is impossible without electricity.
2. The electricity that we get from power outlets and batteries can power all different kinds of devices.
3. The fact is that electricity can be used in a thousand different ways.
4. It is easy to imagine modem people living without electricity.
5. The moving electrons transmit electrical energy from one point to another.
6. If you allow electrons to move through a wire, they will create a magnetic field around the wire.
7. In an electrical circuit, the number of electrons that are moving is called the voltage.
8. The electrons will need to flow from the negative terminal to the positive terminal through a copper wire or some other conductor.
9. In an electric motor, the energy in the electrons creates a magnetic field, and this field can interact with other magnets (through magnetic attraction and repulsion) to create motion.

1.8. Fill in the gaps with the words from the box.

field	electrons	produces	electricity	forces	produce

How can you make electricity with magnets?

You can make 1___by moving a magnet past a wire. The magnet has a magnetic 2 ___ around it – something that exerts forces on magnetic poles. If you move the magnet and its magnetic field, you create an electric field – something that exerts 3 ___ on electric charges. That's because whenever a magnetic field changes with time, it creates an electric field. This electric field will push on the mobile 4 ___ in a wire. So when you move a magnet past a wire, you are producing a changing magnetic field in the wire. This changing magnetic field 5 ___ an electric field and the electric field makes the electrons in the wire accelerate. The moving electrons are electricity. Generators move magnets past wires (or wires past magnets) to 6 ___ electricity.

UNIT 6: ELECTRIC POWER SOURCES

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

to contain – включать в состав, содержать;
coil of wire – катушка;
electric circuit – электрическая цепь;
current – ток;
to push on – толкать;
electric charge – электрический заряд;
eventually – фактически;
to mount – устанавливать;
spindle – вал;
to spin – вращать(-ся);
to propel – вращать(-ся);
light bulb – лампа накаливания;
light emitting diode – светодиод;
terminal – порт, клемма, контакт;
shaft – вал;
to waste – терять, расходовать;
to convert – преобразовывать;
to quadruple – увеличивать в четыре раза;
power loss – потеря мощности;
trivial – малозначимый;
associated with – связанный;
torque – крутящий момент ;
crank – рычаг;
to exert – прилагать (силу);
to pass through – проходить;
load – нагрузка, *зд.* заряд, потребитель электроэнергии.

TEXTWORK

Translate the following text into Russian.

Electric Power Generation

Generators and motors are very closely related and many motors that contain permanent magnets can also act as generators. If you move a permanent magnet past a coil of wire that is part of an electric circuit, you will cause current to flow through that coil and circuit. That’s because a changing magnetic field, such as that near a moving magnet, is always accompanied in nature by an electric field.

While magnetic fields push on magnetic poles, electric fields push on electric charges. With a coil of wire near the moving magnet, the moving magnet’s electric field pushes charges through the coil and eventually through the entire circuit. A convenient arrangement for generating electricity endlessly is to mount a permanent magnet on a spindle and to place a coil of wire nearby. Then as the magnet spins, it will turn past the coil of wire and propel currents through that coil.

If you take a common DC* motor out of a toy and connect its two electrical terminals to a 1.5 V light bulb or a light emitting diode (try both directions with an LED because it can only carry current in one direction), you’ll probably be able to light that bulb or LED by spinning the motor’s shaft rapidly. A DC motor has a special switching system that converts the AC* produced in the motor’s coils into DC for delivery to the motor's terminals, but it's still a generator. So the easiest answer to your question is: "Find a nice DC motor and turn its shaft".

There is no fundamental limit to how much current a generator can handle, however, the characteristics of the generator's wiring, its magnetic fields, and the machinery turning it all tend to limit its current capacity. A generator's wires aren't perfect and, as the current passing through the generator increases, its wires waste more and more power.

Like any wiring, a generator's wires convert electric power into thermal power in proportion to the square of the current. Thus if you double the current in the generator, you quadruple the power loss. While this power loss and the resulting heat are trivial at low currents, they become serious problems at high currents. Increasing the current in the generator also affects its magnetic fields because currents are magnetic.

At a low current, the current's magnetism can be ignored. But when a generator is handling a very large current, the magnetic fields associated with that current are no longer small perturbations on the generator's normal magnetic fields and the generator may not perform properly any more.

Finally, a generator's job is to transfer energy from a mechanical system to the electric current passing through it. As the amount of current in the generator increases, the amount of work that the mechanical system provides must also increase – the generator becomes harder to turn. There will always be a limit to how much torque an engine or crank can exert on the generator to keep it spinning and thus there will be a limit to how much current the generator can handle.

As for how the current varies with load: the more current the load permits to pass through it, the more current will pass through the generator. Assuming that the generator is well built and has very little electric resistance, the load will serve to limit the current. The generator will then deliver just as much current as the load will permit. If the load permits more current, the generator will deliver more. As a result, the wires in the generator will waste more power as heat, the magnetic fields in the generator will become more complicated, and the device powering the generator will have to work harder to keep the generator turning.

TEXT AND VOCABULARY EXERCISES

1.1. Find in the text the words or phrases which mean the same as:

- содержать;
- катушка;
- бесконечно;
- удобный;
- вращающий момент;
- электрический ток;
- в конечном счете;
- ограничивать;
- серьезные проблемы;
- двигатель;
- сопротивление;
- провод.

1.2. Match each word in A with the Russian equivalent in B.

A	B
1. charge;	a. полюс;
2. pole;	b. производство;
3. circuit;	c. заряд;
4. generating;	d. поставлять;
5. to deliver;	e. цепь;
6. power;	f. энергия.

1.3. Work in pairs and decide whether these statements are true or false.

1. Generators and motors are very closely related and many motors that contain permanent magnets can also act as generators.
2. A changing magnetic field is never accompanied in nature by an electric field.
3. There is no fundamental limit to how much current a generator can handle.
4. A generator's wires do not convert electric power into thermal power in proportion to the square of the current.
5. At a low current, the current's magnetism can be ignored.
6. A generator's job is to transfer energy from a mechanical system to the electric current passing through it.
7. As the amount of current in the generator increases, the amount of work that the mechanical system provides must also increase – the generator becomes harder to turn.
8. Wires in the generator will waste more power as heat, the magnetic fields in the generator will become more complicated, and the device powering the generator will have to work harder to keep the generator turning.

1.4. Fill in the gaps with the words from the box.

form	homes	power	distances	transformer	industry

To solve the problem of sending power over long 1 __, George Westinghouse developed a device called a 2 __. The transformer allowed power to be efficiently transmitted over long distances. This made it possible to supply power to 3 __ and businesses located far from the electric generating plant. Despite its great importance in our daily lives, most of us rarely stop to think how life would be like without power. Yet like air and water, we tend to take power for granted. Every day, we use 4 __ to do many functions for us – from lighting and heating/cooling our homes, to being the power source for televisions and computers. Power is a controllable and convenient 5 __ of energy used in the applications of heat, light and power. Today, the United States (U.S.) electric power 6 __ is organized to ensure that an adequate supply of power is available to meet all demand requirements at any given instant.

UNIT 7: ELECTRIC POWER DISTRIBUTION

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

alternating electric current – переменный электрический ток;
incompatible – несовместимый
direct connection – прямое подключение;
to involve – вовлекать, включать;
feedback process – процесс с обратной связью;
to share – делиться, делать общим;
magnetic core – магнитный сердечник;
to be accompanied by – в сочетании с;
to push forward – толкать вперёд;
a step-down transformer – понижающий трансформатор
to be stored – накапливаться;
reasonable amount – достаточное количество;
resistance – сопротивление;
voltage drop – потеря, перепад напряжения.

TEXTWORK

Read the text below to find answers to the given questions.

More Facts about Electricity

1. What does a transformer do?

A transformer transfers power between two or more electrical circuits when each of those circuits is carrying an alternating electric current. Transfers of this sort are important because many electric power systems have incompatible circuits - one circuit may use large currents of low voltage electricity while another circuit may use small currents of high voltage electricity. A transformer can move power from one circuit of the electric power system to another without any direct connections between those circuits.

2. How does a transformer change voltage and how does it regulate the amperage?

A transformer's current regulation involves a natural feedback process. To begin with, a transformer consists of two coils of wire that share a common magnetic core. When an alternating current flows through the primary coil (the one bringing power to the transformer), that current produces an alternating magnetic field around both coils and this alternating magnetic field is accompanied by an alternating electric field (recall that changing magnetic fields produce electric fields).

This electric field pushes forward on any current passing through the secondary coil (the one taking power out of the transformer) and pushes backward on the current passing through the primary coil. The net result is that power is drawn out of the primary coil current and put into the secondary coil current.

3. How does a transformer reduce voltage?

When you send an alternating current through the primary coil of wire in a transformer, that current produces a magnetic field in the transformer. Because the current in the primary coil is changing with time – it's an alternating current - this magnetic field is changing and changing magnetic fields are accompanied by electric fields. In the transformer, this electric field pushes electric charges around the secondary coil of wire in the transformer.

Since these electric charges are pushed in the direction they are travelling, work is being done on them and their energies are increasing. However, in the transformer the secondary coil of wire has fewer turns in it than the primary coil of wire. As a result, the charges don't receive as much energy per charge (as much voltage) as the charges in the primary coil are giving up. This type of transformer, in which the secondary coil has fewer turns of wire than the primary coil, is called a step-down transformer and reduces the voltage of an alternating current.

4. What is the purpose of the iron core in a transformer?

The iron core of a transformer stores energy as power is being transferred from the primary circuit to the secondary circuit. This energy is stored as the magnetization of that iron. The transformer needs to store that energy for roughly one half cycle of the alternating current or about l/120th of a second. The more iron there is in the transformer, the more energy it can store and the more power the transformer can transfer from the primary circuit to the secondary circuit.

Without any iron, the energy must be stored directly in empty space, again as a magnetization. But space isn't as good at storing magnetic energy as iron is so the iron increases the power-handling capacity of a transformer. Without the iron, the transformer must operate at much higher frequencies of alternating current in order to transfer reasonable amounts of power.

5. What is the difference between current and voltage?

Current is the measure of how many charges are flowing through a wire each second. A 1-ampere current involves the movement of 1 Coulomb of charge (6,250,000,000,000,000,000 elementary charges) per second. Voltage is the measure of how much energy each charge has. A 1- volt charge carries 1 Joule of energy per Coulomb of charge. To use water in a pipe as an analogy, current measures the amount of water flowing through the pipe and voltage measures the pressure (or energy per liter) of that water.

6. What is resistance?

Resistance is the measure of how much an object impedes the flow of electricity. The higher an object's resistance, the less current will flow through it when you expose it to a particular voltage drop. To use the water analogy, resistance resembles a constriction in a pipe. The narrower the pipe (higher the resistance), the harder it is to push water through that pipe. If you keep the water pressure constant (constant voltage drop) as you narrow the pipes (increase the resistance), then less water will flow (the current will drop).

7. What causes large electric resistances?

Thin wires or wires made of poor conductors. Some metals are simply better at carrying current without wasting energy than other metals. It has to do with how often a charge bounces off of a metal atom and loses energy. Copper, silver, and aluminum are good conductors while stainless steel and lead are pour conductors. Metals tend to become better conductors as you cool them and worse as you heat them. Semiconductors such as carbon (graphite) are poor conductors but have the reverse temperature effect. At low temperature they are poor conductors but become good conductors at high temperature.

8. How does hydroelectric power work?

Hydroelectric power begins with water descending from an elevated reservoir, such as a lake in the mountains. While it's in the elevated reservoir, this water has stored energy – in the form of gravitational potential energy. As this water flows downward through a pipe, its gravitational potential energy becomes either kinetic energy or pressure potential energy or both. By the time the water arrives at the hydroelectric power plant, it is either travelling very quickly or has an enormous pressure or both. In the power plant, the water flows past the blades of a huge turbine and does work on those blades. The blades are shaped somewhat like airplane wings and they "fly" through the moving water. Since the blades are attached to a central hub, they cause this hub to rotate and allow it to turn the rotor of a huge electric generator. The rotor of the generator typically contains a giant electromagnet. The electromagnet turns within a collection of stationary wire coils and it induces electric currents in those coils. These electric currents carry power out of the generator to the homes or business that needs it.

Notes on the text:

natural feedback process – естественный процесс обратной связи.

TEXT AND VOCABULARY EXERCISES

1.1. Find in the text the words or phrases which mean the same as:

- электростанция;
- серебро;
- железо;
- давление;
- проводник;
- полупроводники;
- высокое напряжение электричества;
- низкое напряжение;
- регулировать;
- частота;
- сопротивление;
- углерод;
- медь;
- не тратя впустую энергию.

1.2. Translate into Russian the following words and word combinations.

Incompatible circuits; low voltage electricity; direct connections; secondary coil; primary circuit; power-handling capacity; frequencies of alternating current; resistance; water descending from an elevated reservoir; to store energy; hub; wire coils; to turn the rotor.

1.3. Find in the text the synonyms to the following words.

■ variable; ■ straight; ■ rule;
■ initial; ■ diminish; ■ enlarge;
■ start; ■ revolve; ■ require.

1.4. Choose among the words in parentheses the one that corresponds to the text above to complete the sentences.

1. A transformer transfers power __ two or more electrical circuits.
(a. between; b. in; c. within)
2. A transformer __ move power from one circuit of the electric power system to another without any direct connections between those circuits.
(a. may; b. can; c. must)
3. The type of transformer, in which the secondary coil has __ turns of wire than the primary coil, is called a step-down transformer.
(a. smaller; b. greater; c. fewer)
4. The transformer needs to __ the energy for roughly one half cycle of the alternating current.
(a. store; b. pass; c. deliver)
5. Resistance is the measure of how much an object impedes the flow of __.
(a. gravity; b. electricity; c. magnetism)
6. Copper, silver, and aluminum are __ conductors.
(a. good; b. poor; c. bad)
7. Hydroelectric power begins with water __ from an elevated reservoir, such as a lake in the mountains.
(a. ascending; b. climbing; c. descending)
8. The electromagnet turns __ a collection of stationary wire coils and it induces electric currents in those coils.
(a. beneath; b. within; c. above)

UNIT 8: USE OF ELECTRIC POWER

ACTIVE VOCABULARY

Read and memorize the following words and word combinations:

repulsive force – отталкивающая электрическая сила;
to twist – вращать;
magnetic pole – магнитный полюс;
vice versa – наоборот;
to undergo – подвергаться, испытывать;
angular acceleration – угловое ускорение;
to exert force – прилагать силу;
to wrap – наматывать;
current-carrying coil – токовая катушка;
loop – петля;
three-phase induction motor – трёхфазный индукционный мотор;
to interact – взаимодействовать;
to be recognized – быть известным;
drag force – тяговая сила;
arrangement – расположение;
to press the button – нажать кнопку;
iron rod – металлический стержень;
to diminish – уменьшать(-ся), затухать;
to rebound – отскакивать;
to overshoot – перескакивать;
pitch – высота звука;
to release the button – отпустить кнопку;
to vanish – исчезать, затухать;
spring – пружина;
linear electric motors – контурный электромотор;
to run on – работать, приводить в движение;
to reverse – менять направление;
to chase – догонять.

TEXTWORK

Read the text below to find answers to the given questions.

Electric Motors

1. How does an electric motor work?

An electric motor uses the attractive and repulsive forces between magnetic poles to twist a rotating object (the rotor) around in a circle. Both the rotor and the stationary structure (the stator) are magnetic and their magnetic poles are initially arranged so that the rotor must turn in a particular direction in order to bring its north poles closer to the stator's south poles and vice versa.

The rotor thus experiences a twist (what physicists call a torque) and it undergoes an angular acceleration – it begins to rotate. But the magnets of the rotor and stator are not all permanent magnets. At least some of the magnets are electromagnets. In a typical motor, these electromagnets are designed so that their poles change just as the rotor's north poles have reached the stator's south poles. After the poles change, the rotor finds itself having to continue turning in order to bring its north poles closer to the stator's south poles and it continues to experience a twist in the same direction.

2. How does electric current create magnetic poles in metal? When the current goes through the metal, what makes it positive and negative?

An electric current is itself magnetic – it creates a structure in the space around it that exerts forces on any magnetic poles in that space. The magnetic field around a single straight wire forms loops around the wire – the current's magnetic field would push a magnetic pole near it around in a circle about the wire. But if you wrap the wire up into a coil, the magnetic field takes on a more familiar shape.

The current-carrying coil effectively develops a north pole at one end of the coil and a south pole at the other. Which end is north depends on the direction of current flow around the loop. If current flows around the loop in the direction of the fingers of your right hand, then your thumb points to the north pole that develops at one end of the coil.

3. In a three-phase induction motor, there is a rotating magnetic field in the stator, which induces a rotating magnetic field in the rotor. Those two magnetic fields will interact together to make the rotor turn. Is the interaction attractive or repulsive?

The magnetic interaction between the stator and the rotor is repulsive – the rotor is pushed around in a circle by the stator's magnetic field; it is not pulled. To see why this is so, imagine unwrapping the curved motor so that instead of having a magnetic field that circles around a circular metal rotor you have a magnet (or magnetic field) that moves along a flat metal plate. As you move this magnet across the plate, it will induce electric currents in that plate and the plate will develop magnetic poles that are reversed from those of the moving magnet – the two will repel one another. That choice of pole orientation is the only one consistent with energy conservation and is recognized formally in "Lenz's Law".

For reasons having to do with resistive energy loss and heating, the repulsive forces in front of and behind the moving magnet don's cancel perfectly, leading to a magnetic drag force between the moving magnet and the stationary plate. This drag force tends to push the plate along with the moving magnet. In the induction motor, that same magnetic drag force tends to push the rotor around with the rotating magnetic field of the stator. In all of these cases, the forces involved are repulsive – pushes not pulls.

4. How does a fan motor work?

A fan motor is an induction motor, with an aluminum rotor that spins inside a framework of stationary electromagnets. Aluminum is not a magnetic metal and it only becomes magnetic when an electric current flows through it. In the fan, currents are induced in the aluminum rotor by the action of the electromagnets. Each of these electromagnets carries an alternating current that it receives from the power line and its magnetic poles fluctuate back and forth as the direction of current through it fluctuates back and forth.

These electromagnets are arranged and operated so that their magnetic poles seem to rotate around the aluminum rotor. These moving/changing magnetic poles induce currents in the aluminum rotor, making that rotor magnetic, and the rotor is dragged along with the rotating magnetic poles around it. After a few moments of starting, the spinning rotor almost keeps up with the rotating magnetic poles. The different speed settings of the fan correspond to different arrangements of the electromagnets, making the poles rotate around the aluminum rotor at different rates.

5. How does an electromagnetic doorbell work?

When you press the button of an electromagnetic doorbell, you complete a circuit that includes a source of electric power (typically a low voltage transformer) and a hollow coil of wire. Once the circuit is complete, current begins to flow through it and the coil of wire becomes magnetic. Extending outward from one end of the coil of wire is an iron rod. When this coil of wire – also called a solenoid – becomes magnetic, so does the iron rod. The iron rod becomes magnetic in such a way that it's attracted toward and into the solenoid, and it accelerates toward the solenoid. The attractive force diminishes once the rod is all the way inside the solenoid, but the rod then has momentum and it keeps on going out the other side of the solenoid. It travels so far out of the solenoid that it strikes a bell on the far side – the doorbell!

The rod rebounds from the bell and reverses in motion. It has traveled so far out the other side of the solenoid that it's attracted back in the opposite direction. The rod overshoots the solenoid again and, in some doorbells, strikes a second bell having a somewhat different pitch from the first bell. After this back and forth motion, the rod usually settles down in the middle of the solenoid and doesn't move again until you stop pushing the button. Once you release the button, the current in the circuit vanishes and the solenoid and the rod stop being magnetic. A weak spring then pulls the rod back to its original position at one end of the solenoid.

6. How do electric/magnetic linear drives work?

Linear electric motors are very much like rotary electric motors – they use the forces between magnetic poles to push one object relative to another. But while a rotary motor uses these forces to twist a rotor around in a circle, a linear motor uses these forces to push a carriage along a track.

Both the carriage and the track must contain magnets and at least some of these magnets must be electromagnets that can be turned on and off, or reversed. By timing the operations of the electromagnets properly, the linear motor pushes or pulls the carriage along the track smoothly and continuously.

7. *What is the difference between a single-phase electric motor and a three-phase motor?*

To keep the center component or "rotor" of an electric motor spinning, the magnetic poles of the electromagnets surrounding the rotor must rotate around it. That way, the rotor will be perpetually chasing the rotating magnetic poles. With single-phase electric power, producing that rotating magnetic environment isn't easy. Many single-phase motors use capacitors to provide time-delayed electric power to some of their electromagnets. These electromagnets then produce magnetic poles that turn on and off at times that are delayed relative to the poles of the other electromagnets.

The result is magnetic poles that seem to rotate around the rotor and that start it turning. While the capacitor is often unnecessary once the rotor has reached its normal operating speed, the starting process is clearly rather complicated in a single phase motor. In a three phase motor, the complicated time structure of the currents flowing through the three power wires makes it easy to produce the required rotating magnetic environment. With the electromagnets surrounding the rotor powered by three-phase electricity, the motor turns easily and without any starting capacitor. In general, three-phase motors start more easily and are somewhat more energy efficient during operation than single-phase motors.

8. Does the monorail at Disneyland and the metro in D.C. run on the idea of direct current motors?

Those trains probably run on AC motors, because then they can use transformers to transfer power between circuits. Most likely, these trains use induction motors. To reverse the direction of the train, the engineer reverses the direction in which magnetic poles in the motors' stators circle the motors' rotors. When the poles reverse directions, the rotor has to reverse its direction, too, so that it chases those poles around in a circle.

TEXT AND VOCABULARY EXERCISES

1.1. Find in the text words or phrases which mean the same as:

- постоянная структура;
- направление;
- постоянный магнит;
- металлическая пластина;
- магнитный полюс;
- вентилятор;
- вращать;
- вращающий момент;
- энергия сопротивления;
- взаимодействие;
- пружина;
- колебаться.

1.2. Make up situations using the English equivalents of the words given above.

1.3. Give Russian equivalents to the following word combinations.

Repulsive forces; stationary structure; particular direction; in order to …; angular acceleration; permanent magnets; familiar shape; resistive energy; induction motor; alternating current; changing magnetic poles; electromagnetic doorbell; to complete a circuit; coil of wire; inside the solenoid; a weak spring; to twist a rotor; to push a carriage; to rotate around the rotor; magnetic environment; to transfer power; to reverse the direction.

1.4. Work in pairs, think of some questions to review the contents of the text and ask each other. Use the word combinations below:

- electric motor;
- magnetic interaction;
- magnetic poles;
- resistive energy;
- rotor;
- to provide electric power;
- stator;
- capacitor.

1.5. Read the text once more. In pairs, discuss the statements below. Say what you think about them and ask your partner if he/she agrees or disagrees with you. Use the following phrases to help you.

Agreeing	**Disagreeing politely**
I agree with you.	Yes, but do not you think … ?
Yes, that is what I think too.	True, but I think …
You are right!	I see what you mean, but …
Undoubtedly.	I don't think so.
Exactly.	Quite the opposite.
That's true.	I am not sure.

1. An electric motor uses only repulsive force between magnetic poles to twist a rotating object (the rotor) around in a circle.
2. An electric current is itself magnetic – it creates a structure in the space around it that exerts forces on any magnetic poles in that space.
3. If current flows around the loop in the direction of the fingers of your right hand, then your thumb points to the North Pole that develops at one end of the coil.
4. The magnetic interaction between the stator and the rotor is not repulsive.
5. A fan motor is an induction motor, with an aluminum rotor that spins inside a framework of stationary electromagnets.
6. When you press the button of an electromagnetic doorbell, you complete a circuit that includes a source of electric power.
7. Linear electric motors are not like rotary electric motors – they do not use the forces between magnetic poles to push one object relative to another.
8. To keep the center component or "rotor" of an electric motor spinning, the magnetic poles of the electromagnets surrounding the rotor must rotate around it.

1.6. Fill in the gaps with the words from the box.

plant	device	dangerous	delivery	transferred
possible	charges	transformer	distant	direct

The genius of George Westinghouse and Nikola Tesla in the late 1800's was to realize that producing alternating current made it 1 __ to transfer power easily from one electric circuit to another with the help of an electromagnetic 2 __ called a transformer. When an alternating electric current passes through the primary wire coil of a transformer, the changing magnetic and electric fields that this current produces transfer power from that primary current to the current passing through another coil of wire - the secondary coil of the 3__. While no electric 4 __ move between these two wires, electric power does. With the help of a transformer, it's possible for a generating 5 __ to move power from a large current of relatively low energy electric charges – low voltage charges – to a small current of relatively high-energy electric charges – high voltage charges. This small current of high voltage electric charges can move with relatively little power loss through miles and miles of high voltage transmission lines and can go from the generating plant to a 6 __ city without wasting much power.

Upon arrival at the city, this current can pass through the primary coil of another transformer and its power can be 7 __ to a large current of relatively low voltage charges flowing through the secondary coil of that transformer. The latter current can then deliver this electric power to your neighborhood. A transformer can't transfer power between two circuits if those circuits operate with 8 __ current. Edison tried to use direct current in his power 9 __ systems. Edison even invented the electric chair to "prove" that alternating current was much more 10 __ than direct current. Still, Westinghouse and Tesla won out in the end because they had the better idea __.

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