МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ
ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ОБРАЗОВАНИЮ

Государственное образовательное учреждение
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«Оренбургский государственный университет»

Кафедра иностранных языков естественнонаучных и инженерно-технических специальностей

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ENGINEERING MATERIALS

МЕТОДИЧЕСКИЕ УКАЗАНИЯ НА АНГЛИЙСКОМ ЯЗЫКЕ

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Методические указания содержат языковые и речевые упражнения, направленные на развитие навыков межкультурной коммуникации студентов естественнонаучных и инженерно-технических специальностей по профессионально значимым темам.

Данные методические указания предназначены для студентов I-II курсов естественнонаучных и инженерно-технических специальностей. Цель указаний – развитие профессионального мышления инженера в процессе коммуникативного обучения иностранному языку.

ББК 81.2 Англ я73

Содержание

Введение

Обучение иностранному языку на естественнонаучных и инженерно-технических специальностях характеризуется рядом особенностей, главная из которых – профессиональная направленность обучения, с одной стороны, представляющая определенную трудность; с другой, открывающая новые возможности и перспективы лингвообразования.

Дисциплина «Иностранный язык» имеет большой потенциал в деле формирования профессионального мышления будущего инженера. Так, необходимый для усвоения материал подлежит усвоению в коммуникативно-проблемной форме, делая процесс обучения действенным и интересным; при этом наблюдается преемственность курсов и дисциплин, что в свою очередь способствует системному, всестороннему усвоению нужных тем.

Представленные методические указания предлагают профессионально ориентированные языковые и речевые упражнения, упражнения в поисковом, обучающем, просмотровом чтении, объединенные тематическим принципом. Все 4 представленных раздела идентичны по структуре: начинаются с речевого введения, предлагающего студентам порассуждать над тематической проблемой; далее следуют упражнения в чтении – предтекстовые, собственно тексты по теме и послетекстовые – речевые. Кроме того, в указаниях имеются дополнительные тексты для просмотрового чтения по представленным темам, призванные расширить полученные знания студентов, а также список терминов необходимых для успешного понимания профессионально ориентированной информации.

1 Part 1

Electricity Basics

1.1. Lead-in

1.1.1 Discuss the following questions

a) Can you imagine our life without electricity?
b) What benefits can we get from electricity?

1.1.2 Some students are writing their coursework now. Suddenly the light went off. Read their conversation to see how they will solve this problem

Olga: Alex, I need your help badly. I'd like you to have a look at my table lamp.
Alex: What is wrong with it?
Olga: I have no idea. I was writing my coursework when suddenly the light went off. Can you repair it?
Alex: I'll try. Give me the lamp.
Olga: Well?
Alex: No wonder the light doesn't work. The **bulb** has a broken **filament.**
Olga: What do you mean?
Alex: The bulb has simply **burnt out**. All we have to do is to **turn** the burnt bulb **out of the socket** and replace it with a new bulb. Do you have one?
Olga: Unfortunately not. And my roommates are all asleep - I can't ask them. You can't lend me your own lamp, can you?
Alex: Well, yes. But it is time to sleep already. Why don't you finish the coursework in the morning?
Olga: You see, my supervisor asked me to bring it to the consultation tomorrow. He expects me to finish it.
Alex: OK. Don't sit up too late anyway. I'll ask Irene to bring you a new bulb. Don't switch on the power till you have turned it into the socket.
Olga: I won't. Thanks a lot.

1.1.3 Complete the dialogues

1. - Nick, I need you to …
   - …? It was all right ten minutes ago.
2. - I'm afraid …
   - Don't worry. We'll ask somebody to ...
3. - Let's…
   - Well?
   - You see, …
   - What shall we do?
   -.... But I'd like you to ... the power first.
   -…
   -I'm sure you won't forget to turn on the ... again. The light will let ... your report.

1.1.4 Look up the following terms in the dictionary. Practice reading them

Alteration, bulb, cell, charged elements, circuit, electrical current (direct and alternating), dielectric, filament, to transmit, transmission grid, insulator, power (thermal, nuclear, underground steam, solar, kinetic, chemical power), power plant, rectifier, socket, transformer (step-up, step-down transformers), capacitor, condenser, winding (input, output or primary and secondary winding), wire, overhead conductor wire, resistance, to glow, notions, frequency, to reverse, a flow, mica.

1.1.5 Cross out the odd word. All the words in the line should belong to the same part of speech

1) complete, carry out, measurement, perform,
2) wire, bulb, socket, switch off,
3) winding, capacitor, frame, rectify,
4) current, power, electrical, flow,
5) into, out of, from, careful,
6) transformer, alternate, rectifier, generator,
7) voltage, insulate, frequency, resistance.

1.1.6 Look at the title and say what information the text "Electricity Basics" gives. Read the text attentively for the details

Electricity is something we do not notice until we do not have it. However, few people understand what it is and still fewer can explain it. Let us try it anyway.

So, what is electricity? Electricity is simply a movement of **charged** particles through a closed **circuit.** The electrons, which flow through this wire, carry a negative charge. A lightning discharge is the same idea, just without the **wire.**

Electricity is made by converting some form of energy into flowing electrons at the power plant. The type of power plant depends on the source of energy used: **thermal power** (coal, oil, gas, nuclear, underground steam), **solar power** (photovoltaic), **kinetic power** (water, wind) and **chemical power** (fuel cell).

After it is made, electricity is sent into a system of cables and wires called a **transmission grid.** This system enables power plants and end users to be connected together.

The basic notions in electricity include the following.

An **Amp** (A) is a unit measure of amount of current in a circuit. An ammeter permits the current to be measured.

The pressure that forces the current to flow is measured in **Volts** (V). A **transformer** is used to change the voltage of electricity. This allows electricity to be transmitted over long distances at high voltages, but safely used at a lower voltage.

A **Watt** (W) is a unit measure of electric power that depends on amps and volts. The more watts the bulb uses the more light is produced. Watts = Volts x Amps.

An **Ohm** (O) is a unit measure of materials resistance to a flowing current. The **filament** in this light bulb glows because its high **resistance** makes it hot. Low resistance of the support wires does not let them glow. The glass has a resistance so high that it does not allow the current to move through it - this property makes glass a good **insulator.**

There are two different kinds of **electrical current.** One is called **direct current** because electrons are made to move in one direction only. It is usually abbreviated to DC. This kind of electricity is produced by a battery.

AC Stands for **alternating current**, which is generated by power station for domestic and industrial use. The wires in the centre of the generator rotate past the North and the South poles of the magnet. This movement forces the electrons in the circuit to reverse the direction of their flow. The number of these alterations (or cycles) per second is known as **frequency**.

As domestic supply requires alternating current it is therefore necessary to change it to direct current inside most electrical appliances. A **rectifier** allows AC to be converted into DC.

Power stations are designed to provide electrical energy to large housing developments. This causes the necessity to transmit power from its source, the generating station, to wherever it is required for use, which maybe far away, with minimal energy losses. It is cheaper and easier to carry a very high voltage but low current, over long distances. It can be done with the help of thinner overhead conductor wires, with an air gap between them to act as an insulator.

A transformer is used to increase or decrease the voltage of an electric power supply. This is a static machine since it has no moving parts. It consists of two coils of wire that are wound around a soft iron core. The coils are called **windings**, one is the **primary, or input winding**, and the other is the **secondary, or output winding.**

When current passes through the primary winding, a magnetic field is created around the iron core, which induces a voltage in the secondary winding. If the number of turns in the secondary winding is greater than that in the primary winding it is a step-up transformer and the output voltage is greater than the input voltage. And vice versa, a step-down transformer enables the input voltage to be reduced.

A device, which allows an electrical charge to be build up and stored for some time is known as a **capacitor (or a condenser).** A simple capacitor is made from two metal plates (electrodes), which are separated by an insulator such as air, paper or mica (**the dielectric**).

1.1.7 Say if the following statements are true or false. Correct the false statements

1. There are two different kinds of electricity: AD and BC.
2. Direct current is received from a battery.
3. AC is used for domestic and industrial purposes.
4. The frequency is the number of cycles per second.
5. Conversion is brought about by means of an insulator.
6. Air is a rather good insulator.

7. High voltage is supplied by a transformer.
8. To decrease voltage a step-down transformer should be used.
9. The function of a capacitor is to transmit electricity to electrical appliances.

1.1.8 Explain why...

a) Two kinds of current exist.
b) Electrons change the direction of the flow in AC.
c) A rectifier is necessary.
d) Energy is lost on the way from the power plant to the end user.
e) A high voltage and low current are transmitted through the wires.
f) A transformer is used.
g) A transformer is known as a static machine.
h) A step-up transformer permits the input voltage to be increased.
i) A condenser is necessary in domestic appliances.

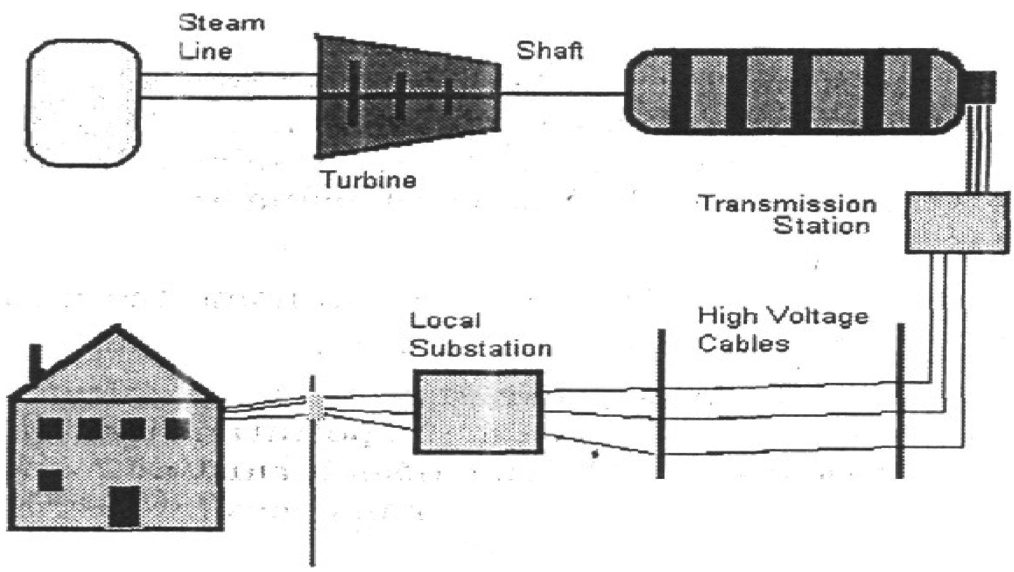
1.1.9 Give another title to the text. Render its contents in 6 simple sentences

1.2 Activity

1.2.1 Create a questionnaire on the topic "Basic Electricity Notions" and test your classmates' knowledge

1.2.2 Describe a step-down transformer, its structure, operation and function. Use the description of a step-up transformer as a model

1.2.3 Study the picture 1 and describe in writing how electricity is produced and then transmitted to our houses



Picture 1

2 Part 2

Energy Problems

2.1. Lead-in

2.1.1. Discuss the following questions

a) What do you know about the energy crisis we are facing today?
b) What solutions can you offer?

2.1.2 Read the students' discussion and name advantages and disadvantages of alternative energy sources

Sveta: Alex, I would like you to read this article. It seems to be very interesting.
Alex: Does it really? What's so special about it?
Sveta: Well, you had better read it by yourself. Anyway, it appears to discuss the energy crisis **threatening** us today.
Alex: Oh, I heard something about it. We consume too much energy and **exhaust** our fossil fuel **resources** consisting of oil, coal and gas. However, technological progress cannot be stopped.
Sveta: Don't worry. The solution is likely to be found anyway. Have you heard about alternative energy sources developed by the scientists all over the world?
Alex: Certainly, these **alternative sources of energy** are assumed to have many advantages, but actually they are very expensive and rather **inefficient.**
Sveta: Well, the new method only needs perfection. Besides, as we are sure to **run out of** fossil fuels soon, do we have other **options**?
Alex: No, we don't. And moreover, the alternative sources of energy seem to be inexhaustible and causing no pollution.
Sveta: That speaks for itself, doesn't it?
Alex: Without any doubts. OK, where is the article? I need further information.
Sveta: Here it is.

2.1.3 Find the meaning and the pronunciation of the following words in the dictionary

Alternative energy sources, exhaust, exhaustible, fossil fuel resources, steam, essential, available, evident, constantly, renewable, nonrenewable, to consume, consumption, shortage, polluting, pollution-free, to satisfy smb's needs, immensely, producing no waste, safe, dangerous, poisonous, dam, turbines, requirements, environment, advantage, disadvantage.

2.1.4 Match the words with the opposite meaning

to accelerate	excess
adequate	pollution free
renewable	inexhaustible
polluting	inadequate

safe	to show down
shortage	unsuitable
expensive	nonrenewable
suitable	dangerous
exhaustible	cheap

2.1.5 Find in B the derivatives from the words in A

A

- civilization, civil, sensible, unsuitable
-converter, conservation, consumption, measurement
-consumer, usable, reduction, increase
-report, comfort, ensure, shortage
-empire, powerfully, sensible, waterwheel
- consist, student, suitable, institute
- example, inexhaustible, exhibition, explanation
- plant, pursuit, production, pollution

B

1. to civilize
2. to consume
3. use
4. short
5. power
6. to suit
7. to exhaust
8. to pollute

2.1.6 Translate the following compound nouns into Russian

Energy crisis prospects, steam engine, oil-equivalent, energy cost, total fuel consumption, overall energy supply.

2.1.7 Read the article carefully for the details about the energy problems

Energy is an essential part of our civilization. A million years ago primitive man used only 6,000 kJ a day, which he got from the food he ate. A hundred thousand years ago people had learnt to make fire and used four times as much energy (the equivalent of 25,000 kJ). By the 15th century man using animals, windmills and waterwheels, and a little coal, was already consuming nearly twenty times as much energy (120,000 kJ). By 1875 the steam engine made 340,000 kJ a day available to industrial man in England. Today's technological man uses 1,000,000 kJ a day, or one hundred and fifty times as much as primitive man, about one third in the form of electricity.

What do we need energy for? Comfort and lighter work, first of all. Energy consumed in great quantities falls into two kinds: a) energy needed every day (lighting, heating, etc.) and b) energy used to produce necessary objects (house, clothes, etc.). Take a man building a small house (10 tons of oil-equivalent), heating

(3 tons of oil-equivalent) and lighting (200 kg of oil-equivalent or 700 kWh) it for a year and having a car (1.3 tons of oil-equivalent + 1.3 tons for every 12.000 km run). The energy cost of these basic things is tremendous but multiply it by 6 billion to get the real picture of man's needs. Besides, energy consumption is sure to increase since the more energy is consumed, the easier our life becomes.

The current energy problem caused by many interrelated factors must be tackled quickly. Strange as it sounds, there is no shortage of primary energy. The sun provides ten thousand times as much energy as we require today, in many forms ranging from solar radiation through wind and waves to trees and plants. The problem is to convert these resources into mechanical work or other usable forms of energy. The history of energy has been the history of converters - man's body itself converting food into warmth and mechanical work, animals doing such work more powerfully, the waterwheel, the windmill, the steam engine, the nuclear reactor and in the near future the solar cell.

2.1.8 Find answers to these questions in the text

1. How did primitive man get the energy he needed?
2. How much energy does man consume today?
3. What does technological man do half of his life?
4. In what two ways is energy used?
5. What is the standard measurement of energy cost?
6. Does the car require much energy?
7. Why is it essential to cut energy consumption?
8. What is the primary source of energy?

2.1.9 Complete the table 1 with the information from the article

Table 1

Time	Man	Years of life	Energy consumption	Why?
...	...	...	...	...

Consider food, domestic consumption, services (trade, office work, teaching and leisure), industry and agriculture, transport.

2.1.10 Think over the following situations

1. What are the ways of using energy? Supply your own examples.
2. How much energy (in oil-equivalent) is necessary to build a house and light and heat it for a year?
3. What is the energy problem? Describe its causes and ways of solving it.
4. Continue the sentence: The less energy we will use, the ... Do you agree? Give reasons for your opinion.
5. What energy sources on the Earth are or have been provided by the Sun?

2.1.11 a) Does the article provide any interesting information? What is the main idea of the article? What other questions does it discuss?

b) Give a title to the article.

2.2 Read the text for detailed information about alternative sources of energy

2.2.1 Text "Alternative Sources of Energy"

It is not a secret that energy consumption has increased immensely in the last decades. But do we have enough fossil fuels to satisfy our needs? As fossil fuels are nonrenewable we are highly interested in developing alternative sources of energy.

Solar Power is renewable. It is used for heating houses. Solar cells and furnace make electricity from sunlight. Solar cells are expensive. Solar power isn't much of use unless you live somewhere sunny. It doesn't cause pollution and doesn't need fuel.

Wind Power is renewable as well. It doesn't cause pollution, doesn't need fuel. However, a lot of generators are needed to get a sensible amount of power. It is necessary to put them where winds are reliable. And the noise can drive you nuts.

Hydroelectric Power plants are built for getting energy from flowing water. Usually we build a dam, and let the water turn turbines and generators as it goes through pipes in the dam. Renewable. No pollution, no fuel needed, no waste. Very expensive to build. Building a dam we flood a lot of land.

Waves Power. There's a lot of energy in waves on the sea. However it is not easy to get it. A wave power station needs to be able to stand really rough weather, and yet still be able to generate power from small waves. This source of energy is renewable - the waves will come whether we use them or not.

Geothermal Energy means heat from underground hot rocks. Hot water comes up and we use the heat to make steam to drive turbines, or to heat houses. It is renewable - so long as we don't take out too much, the energy keeps on coming. However, there are not many places you can do it — the rocks must be suitable. Sometimes we get poisonous gases coming up too.

"Biomass" means burning wood, dung, sugar cane or similar. It is renewable - we can always plant more trees. We burn the fuel to heat water into steam, which drives turbines, which drive generators. Burning anything we pollute the environment.

Nuclear (atomic) power stations use uranium as fuel. It is nonrenewable. Heat from the reactor turns water into steam, which drives turbines, which drive generators. It doesn't cause pollution unless something goes wrong.

2.2.2 Answer the following questions

1. Why do we have to develop alternative sources of energy?
2. What is solar energy used for?

3. What are the disadvantages of wind power?
4. What requirements should hydroelectric power stations meet?
5. Why can the use of geothermal energy be dangerous?
6. Are nuclear power plants considered safe?

2.2.3 Name the sources of energy that are...

1) renewable,
2) pollution-free,
3) producing no waste,
4) needing no fuel,
5) safe.

2.2.4. Can these sources of energy be used in your country? Give your reasons

Power Source	Can Be Used	Cannot Be Used
solar power		
wind power		
hydroelectric power		
waves power		
geothermal power		
biomass		
nuclear power		

2.3 Activity

2.3.1 Your country is running out of fossil fuels soon and is facing an energy crisis. Other sources of energy must be developed quickly. Divide into several groups and make presentations of some projects (consider all the factors both positive and negative), explain your choice and answer possible questions

3 Part 3

Laser

3.1 Lead-in

3.1.1 Discuss the following questions

a) What is a laser? Where are lasers applied?
b) Are lasers dangerous? If so, give your reasons.

3.1.2 Look through the conversation and learn what a laser is and how it works.

Teacher: Hello, my friends. Today, I'm going to show you an operating laser.
Ivan: That's great! By the way, what does the word 'laser' **mean**?

Teacher: It **denotes** light **amplification** by stimulation of emission of radiation. Looking at the operating laser one can see it producing a very powerful **beam of light**.
Ivan: When did the first lasers appear, I wonder?
Teacher: As far as I know, in the 1960s. Yet, we hear of their having numerous applications. Industrial **welding**, cutting materials, making measurements, etc. will be practically impossible without this **device.**
Ivan: And how do lasers work?
Teacher: Their work is based on the principle of **amplifying** the light of a certain **wavelength** in the **resonator cavity.**
Ivan: I'm rather interested in making experiments with laser beams.
Teacher: Then let's try to make one. But be very careful. Lasers can be very dangerous.
Ivan: Why are they dangerous?
Teacher: Well, they produce a very powerful beam of light and if **treated** in the wrong way it can hurt or even kill you.
Ivan: Oh, I'm pretty scared.
Teacher: Don't worry. If you follow all the safety instructions nothing will happen to you.

3.1.3 Match a line in A with a line in B

A	B
1. Are lasers amplifiers or oscillators?	a) It is a device for increasing the strength of a signal.
2. What is an oscillator?	b) Welding, cutting, holography.
3. What is an amplifier?	c) It is a generator or source of light.
4. What makes lasers dangerous?	d) Oscillators.
5. What are lasers used for?	e) When treated inadequately.
6. When does the laser become a source of destruction?	f) They are producing an extremely powerful beam of light.

3.1.4 Match the words with their definitions

1) laser, n	a) to send out heat, light, sound
2) behaviour, n	b) in only one colour
3) cavity, n	c) the larger number or amount.
4) majority, n	d) an apparatus for producing a very hot narrow beam of light used for cutting metals
5) amplifier, n	e) acting in a particular way
6) to emit, v	f) a hole or hollow space in a solid mass
7) monochromatic, adj	g) an instrument for making a signal stronger

3.1.5 Find in the list these parts of speech

(noun) amplify, weak, absorption, to treat
(noun) partially, excited, bounce, pulse

(adjective) activate, solution, flat, principle
(adjective) tiny, purify, majority, totally
(adverb) intense, forth, numerous, since
(adverb) powerful, infrared, exactly, cavity
(preposition) input, actually, via, ultraviolet
(verb) radiation, synthetic, reflective, manipulate
(verb) emit, unique, oscillator, quality

3.1.6 Study the text "The Past and the Future of the Laser" for more detailed information about lasers

A laser is a source of light but unlike anything that had ever been seen before 1960 when Theodore H. Maiman of Hughes Aircraft placed a specially prepared synthetic **ruby rod** inside a powerful **flash lamp similar to** the type used for high-speed photography. Activating the flash lamp produced an **intense pulse** of red light, which possessed the unique properties of monochromicity (the light is of the same **wavelength** or colour), **coherence** (all the waves move precisely in step), and **directionality** (the beam can be easily manipulated). These features account for the enormous difference between the output of a laser and that of an incandescent light bulb.

With Maiman's invention the laser age was born. Everybody became interested in exploring this promising **area** of science. Within a very short time, numerous solid-state materials, gases, liquids, and semiconductor crystals were found possessing laser qualities. Almost every imaginable material was tried in order to produce new and interesting lasers. Even some **varieties** of jelly brand dessert were announced emitting xenon light, and according to this legend, they are supposed to work fairly well.

In many ways, the laser was a solution looking for a problem. Well, the problems soon followed in great numbers. It would be hard to imagine the modern world without lasers. They are used in everything from CD players to laser printers, fibre-optics and free-space communications, industrial cutting and welding, medical and surgical treatment, holography and light shows, basic scientific investigations in dozens of fields, including Star Wars weapons research. The unique characteristics of laser light make these and numerous other applications possible. In fact, it is safe to say that the vast **majority** of laser applications have not yet even been suggested.

However, if **treated** inadequately, an extremely powerful beam of laser light can be a source of **destruction**. You must never stand in the way of the cutting laser beam. Only by looking directly into the beam or its reflection from a shiny object you can damage your eyes. Besides, laser power supply being typically 2500 V or more; a qualified person must provide external power supply, as ordinary insulation is not enough. Thus, no matter how advantageous and useful they are, lasers are dangerous. Hence, safety rules must be strictly observed.

3.1.7 Provide detailed answers to these questions

1. What is a laser? What other sources of light do you know?
2. What was the first laser like?
3. Does the laser possess any unusual properties? What are they?
4. When did the laser age begin?

5. Many substances produce laser light, don't they?
6. Were there any surprising discoveries?
7. Why is it difficult to imagine our life without lasers?
8. What are the most common uses of lasers?
9. Why are lasers considered dangerous?

3.1.8 Explain what the author means by the following statements

1. A laser is a source of light but unlike anything that had ever been seen before 1960.
2. With this invention the laser age was born.
3. According to this legend, they are supposed to work fairly well.
4. In many ways, the laser was a solution looking for a problem.
5.I n fact, it is safe to say that the vast majority of laser applications have not yet even been suggested.
6. If treated inadequately, an extremely powerful beam of laser light can be a source of destruction.

3.1.9 Complete the gaps with suitable words from the box

wavelength	destruction	applications	safety
liquids	intense	powerful	features
coherence	semiconductor		

A laser is a source of monochromatic, directional and coherent light. Monochromicity means light of the same ... or colour. Light waves travelling precisely in step explain the property of ... . Besides, the laser beam can be easily manipulated. These unusual ... make laser light unique. The first laser consisted of a specially prepared synthetic ruby rod and a ... flash lamp. During the experiment the researchers observed an ... pulse of red light. Later solid-state materials, gases, and ... crystals were recorded having laser qualities. Lasers are considered to be a multibillion-dollar industry having numerous … such as cutting and welding. However, lasers can be the source of both construction and ... .That is why ... rules must be strictly observed.

3.1.10 Look up the following words in the dictionary

Amplification, amplifier, oscillator, emission (stimulated or spontaneous), wavelength resonator cavity, to treat inadequately, dangerous, coherence, flash lamp, similar, area of science, destruction, safety rules, liquid, semiconductor, radiation, transparent, inversion, excited particle, upper energy level, acronym, two or three-dimensional pictures.

3.1.11 Do you remember what the word "laser" means? Read the text "How Lasers Work" and learn how lasers work

The word "laser" is an acronym standing for light amplification by stimulated emission of radiation. This is not exactly so since most lasers are actually oscillators (generators or sources of light) and not amplifiers (devices for increasing the strength of a signal), though such lasers are also possible and used for some applications, however, nearly all lasers have the following in common:

1. A lasing medium. This can be a solid, liquid, gas, or semi conductor material, which can be pumped to a higher energy state. A means of pumping energy into the lasing medium can be: optical, electrical, mechanical, chemical, etc.
2. A resonator consisting of a cavity with a pair of mirrors (flat or concave), one at each end of the laser for making stimulated light bounce back and forth through the lasing medium. One of the mirrors is totally reflective, the other being partially transparent to allow the laser beam to escape.

Lasers are based on a simple principle of atomic behaviour. Normally, nearly all atoms, ions, or molecules (depending on the particular laser) of the lasing medium are at their lowest energy level or 'ground state'. To produce laser action, the energy-pumping device must achieve population inversion through driving the majority of particles to the upper energy level. Sometimes dropping to the 'ground state' the excited particle emits a single photon of light. This is called 'spontaneous emission', not exactly useful, although causing the glow of a neon sign or the phosphor coating of a fluorescent lamp. Yet Einstein showed that a photon emitted nearly parallel to the direction of the resonator will bounce back and forth many times stimulating excited particles along the way to lose the photons possessing three exactly the same qualities: wavelength, phase and direction. The tendency progresses resulting in the photons flow increasing via this 'stimulated emission' process. The resulting beam can be pulsed or continuous; visible, infrared or ultraviolet; less than a milliwatt — or millions of watts of power. It has the unique properties of being highly monochromatic, coherent and easily manipulated - something impossible with more common light sources. There you have it! Everything else is just details.

3.1.12 Explain the meaning of these words and expressions

Laser, oscillator, amplifier, photon, ground state, spontaneous emission, stimulated emission.

3.1.13 Give detailed answers to these questions

1. Why is the acronym "laser" not very exact?
2. Do lasers have a common structure?
3. What lies in the basis of laser operation?
4. The lasing medium consists of various particles, doesn't it?
5. What are the stages of emission?
6. In what condition are the particles found normally?
7. Why is it necessary to move the particles to the upper energy level?
8. When do excited particles lose photons?
9. How does the massive flow of photons begin?
10. What is the output of the laser?

3.2 Translate the following passage into Russian in a written form. Use the dictionary if necessary

3.2.1 Text "Lasers in Art and Entertainment"

Lasers make impressive visual effects possible. In light shows it is common to use lasers emitting few laser wavelengths. Prisms are used for separating each colour. This results in producing many laser beams of different colours. The application of small vibrating mirrors controlled by a computer provides the possibility of moving each laser beam very rapidly thus creating moving coloured images; since our vision is based on seeing the image a little time after it has disappeared, we are capable of observing a full picture created by a laser beam in spite of its being illuminated in each point for a very brief period of time. The first devices were used for making two-dimensional moving pictures on screens, but the latest developments are designed with the view of producing three-dimensional moving sculptures in free space - an impossible task to be performed by other means. Without the laser, the unique three-dimensional imaging properties of holography would not exist.

4 Part 4

Engineering Materials: Metals and Non-metals

4.1. Read the text attentively; look up the meaning of unknown words in the dictionary

All engineering materials are divided into **metals and non-metals**. **Copper, cast iron, aluminium** are examples of metals. **Rubber, plastic and ceramics** are examples of non-metals. Today different metals are widely used in machine-building industry.

We can divide all metals into **ferrous and non-ferrous**. Steel and cast iron are in the group of ferrous metals. They are **alloys** of **iron** with **carbon, manganese, silicon** and other components.

Non-ferrous metals are metals and alloys the main component of which is not iron but some other element such as aluminium, copper and others. Some of the characteristics of non-ferrous metals are high electric and heat **conductivity**, high **corrosion resistance**, light weight and easiness of **fabrication**. Steel, copper and aluminium are widely used in engineering. Steel is a grey elastic metal. It is heavier than aluminium, but it is the hardest and the strongest of those three metals. That is why it is widely used for constructing bridges, making tools and car components.

Copper is a red metal. It is harder and stronger than aluminium and more **flexible** than steel. Electric wires are generally made of copper because this metal has a high electric conductivity. However, copper is the heaviest metal of the three.

The lightest and the most flexible of these materials is aluminium, therefore aircraft, engine components and many kitchen items are made of this metal. Aluminium is a white **hard** metal.

4.1.1 Try to answer these questions according to the information given in the text

1. What groups are all engineering materials divided into?
2. Where are different metals used?
3. There are ferrous and non-ferrous metals, aren't there?
4. Are steel and cast iron ferrous or non-ferrous metals?
5. What are non-ferrous metals?
6. What are the characteristics of non-ferrous metals?

4.1.2 Find the endings of these sentences

Steel, copper and aluminium are widely used ...
Steel is the hardest and the strongest of ...
Copper is ...
Steel is ...
The lightest and the most flexible is ...

a red material,
aluminium,
in engineering,
the three metals,
a grey elastic metal.

4.1.3 Complete the sentences

Different metals ... widely ... in .... Steel is a grey... metal. It is ... than aluminium. Copper is a red .... Steel is harder and stronger ... copper, but copper is ... flexible than steel. Copper is the Aluminium is the ... flexible material. Steel is ... hardest and the ... of these three materials.

4.1.4 Translate the following Russian sentences into English

1. Эти инструменты сделаны из различных технических материалов.
2. Существует два типа технических материалов: металлы и неметаллы.
3. Сталь, медь, литейный чугун широко используются для изготовления болтов, винтов, гаек.
4. Как металлы, так и неметаллы обладают определенными свойствами, поэтому они широко используются в производстве технических изделий.
5. Резина - очень прочный материал.
6. Ручка этого молотка сделана из дерева, а обух — из стали.
7. - Олег, дай мне, пожалуйста, эту стеклянную колбу.
8. Будь осторожен, не урони этот предмет. Он сделан из стекла.
9. - Дмитрий, не используй этот медный провод, используй стальной.
10. Пластик - очень легкий материал.

4.1.5 Read the text "Copper" attentively for more information about copper

Copper is the man's oldest metal as people could extract it more than 10,000 years ago. As it is rather soft and ductile, copper is alloyed with other elements. There is evidence that the first copper alloy - bronze (90 % copper, 10 % tin) was produced around 2800 BC in countries such as India, Egypt and Mesopotamia. Bronze was harder and could be used for making reliable cutting tools. Its use characterizes the Bronze Age.

The workability and the ability for corrosion resistance made copper, bronze and brass the most important functional as well as decorative materials from the middle Ages and on till the present day. With the beginning of the Electrical Age the demand for copper increased tremendously because it is an unusually good conductor of electricity and heat. Today more than 5 million tons of copper are produced annually and the copper metals are playing an increasingly vital part in all branches of modern technology.

The good news is that we will not run out of copper. The worldwide resources of this important and valuable metal can be estimated at nearly 5.8 trillion pounds of which only about 0.7 trillion (12 %) have been mined throughout history. Besides, nearly all of 700 billion pounds is still in circulation because copper's recycling rate is higher than that of any other engineering metal. Each year nearly as much copper is recovered from recycled material as is obtained from newly mined ore. Almost half of all recycled copper scrap is old post-consumer scrap, such as discarded electric cable, junked automobile radiators and air conditioners, or even ancient Egyptian plumbing! The remainder is new scrap, such as chips and turnings from screw machine production. Engineers hope that we will be able to use copper for centuries on.

4.1.6 Skim the text to find answers to these questions

1. Is copper the oldest metal that is known to man?
2. What properties does copper possess?
3. What is bronze?
4. When, where and why did bronze appear?
5. What are the applications of copper and its alloys?
6. Why aren't we afraid of working out the resources of copper?

4.1.7 Say if the following statements are true or false. Correct the false statements

1. Copper was extracted by man more than 10,000 years ago.
2. Copper alloys appeared because there was shortage of pure copper.
3. Copper metals are important functional and decorative materials today.
4. In the 19th century the demand for copper greatly decreased.
5. The resources of copper will be worked out in the near future.
6. If Egyptian plumbing is recycled a lot of copper can be obtained.

4.1.8 Agree or disagree with these statements. Give reasons for your answer

1. Copper metals possess valuable properties.
2. Technological progress increases the demand for copper,
3. There is no need to save copper resources.
4. Copper can and should be recycled.

4.2 Read the text "Steel" attentively to learn more about steels

Steel is known as an alloy of iron and about 2 % or less carbon. Pure iron is soft, ductile and malleable, useful only as an ornamental material. However, the addition of carbon hardens it greatly and changes its properties. Steels for special applications may contain other alloying elements beside carbon. This modifies and improves the physical properties of the base steel. For example, small percentages of nickel, chromium, manganese and vanadium may be used for strengthening steels for construction work. Heat treatment (i.e. tempering) and mechanical working at cold or hot temperatures may also give steel alloys superior qualities, such as strength, hardness, toughness, **wear resistance**, corrosion resistance, electrical resistance and workability.

Steel making processes are known as **melting, purifying (refining)** and alloying at about 2,900 F (1,600 °C). Molten steel may be first cast into ingots. Later ingots are worked into finished products. This may be done by two major methods: hot-working and cold-working. The latter is generally used for making bars, wire, tubes, sheets and strips. Molten steel may also be cast directly into products.

Steels vary greatly but the major classes are carbon steels, low-alloy steels (up to 8 % alloying elements, i.e. tool steels), and high-alloy steels (more than 8% alloying elements, i.e. stainless steels).

In carbon steels the carbon content may range from 0.015 % to 2 %. The steel that was used for the Golden Gate Bridge, for instance, is carbon steel with the following average **chemical composition**: C: 0.81 % (0.85), Mn: 0.66 %, P: 0.026 % (0.04), S: 0.028 % (0.04), Si: 0.24 %, the addition of this tiny amount of carbon made the steel much stronger and harder. Carbon steels account for about 90% of the world's steel production. They may be used for automobile bodies, appliances, machinery, ships, containers, and the structures of buildings.

Tool steels are special steels that are engineered to particular service requirements. These expensive alloys are exceptionally strong, hard, wear-resistant, tough, noncreative to local overheating. They contain tungsten, molybdenum, vanadium, and chromium in different combinations, and often cobalt or nickel for better high-temperature performance. They are used for machine tools, aircraft undercarriages, in buildings and bridges. Stainless steels comprise any alloy steel that contains 10-30 % chromium. The presence of chromium, together with the low carbon content gives a remarkable resistance to **corrosion** and heat. Other elements, such as nickel, molybdenum, titanium, aluminium, niobium, copper, nitrogen, sulphur, phosphorus, and selenium may be added for obtaining better corrosion resistance and other valuable properties.

4.2.1 Can you read these chemical elements? If not, find their names in the text

C, S, P, Se, W, Mo, V, Cr, Co, Ni, Ti, Al, Cu, N, Nb

4.2.2 Are these statements true or false? Correct the false statements

1. There are many kinds of steels.
2. Three major classes are carbide steels, low-alloy steels, and high-alloy steels.
3. Carbon steel was used in building the Golden Gate Bridge.
4. Great strength, hardness and other valuable mechanical properties are obtained by the addition of a great amount of carbon.
5. Low-alloy steels are the most popular kind of steel.
6. Tool steel is used for producing automobile bodies, ships and spoons.
7. Tool steel is not cost-efficient.
8. Tungsten, molybdenum, vanadium, and chromium in different combinations may improve high-temperature performance of stain-less steel.
9. A remarkable resistance of stainless steel to corrosion and heat is achieved with the help of chromium and high carbon content.

4.2.3 Choose the right option to complete the sentences

1. Steel is a general name for
   a) non-metals; b) ferrum; c) iron-and-carbon alloys.
2. Physical properties of iron may be modified greatly by the addition of
   a) iron ore; b) hydrogen; c) carbon.
3. Pure iron is used
   a) as an ornamental material; b) for construction work; c) in machine tools.
4. Steel for special applications usually contains
   a) carbon; b) various alloying elements; c) vanadium.
5. Heat treatment and mechanical working at cold or hot temperatures result in ... of steel.
   a) a different carbon content; b) better qualities; c) finished products.
6. Melting, purifying and alloying are the stages of steel
   a) cold-working; b) refining; c) making.
7. Bars, wire, tubes, sheets, and strips are the result of
   a) melting steel; b) hot-working; c) cold-working.

4.2.4 Today you have been given a lecture on steels. You have not under stood it very well. Your friend is good at materials science. Ask him to explain to you clearly what steels are and how they are produced. If you find the task too difficult, make up a list of the questions you are going to ask

4.3 Polymers influence all spheres of our life. Read the text attentively for the detailed information about polymers

4.3.1 Text "Plastics"

Whether you are aware of it or not, plastics play an important part in your life. From the car you drive to work to the television you watch when you get home, plastics help to make your life easier and better. How?

Plastics are **polymers -** long chains of many units that are usually made of carbon, hydrogen, oxygen, and/or silicon. Polymers have been with us since the beginning of time - tar, amber and horns are the easiest examples. In the 1800s these natural polymers were chemically modified and many materials such as vulcanized rubber and celluloid were produced. The first truly **synthetic** polymer Bakelite was developed in 1909 and was soon followed by the first synthetic **fibre**, rayon, in 1911.

Polymers come in a great variety of characteristics and colours. This fact alone must be considered as an advantage of these materials. They are cheaper and easier to make than, say, paper. Besides, polymers possess the properties of easy processing, **durability,** light weight, sufficient strength, thermal and electrical insulation and resistance to chemicals, corrosion and shock. These valuable qualities of polymers can be further enhanced by a wide range of additives, which broaden their uses and applications.

Unfortunately we have to admit that plastics pollute the environment. Luckily, most polymers are thermoplastic (e.g. nylon, polythene), i.e. they can be heated and reformed again. The recycled plastics keep all their properties when they are combined with virgin plastics. The other group of polymers, **thermosets** (e.g. bakelite, phenolic resin), must not be recycled, as reheating causes their deformation. However, the controlled **incineration** of thermosets converts waste into heat energy.

The usefulness of plastics can only be measured by our imagination. These are definitely the materials of past, present, and future generations.

4.3.2 Skim the text to find answers to these questions

1. What are the applications of plastics?
2. What is a polymer?
3. Are there any natural polymers?
4. What was the first synthetic polymer and when was it developed?
5. Do polymers possess valuable properties?
6. What is the disadvantage of plastics?
7. How can pollution by plastics be reduced?

4.3.3 Say if the following statements are true or false. Correct the false statements

1. Plastics influence our life greatly.
2. Conventional polymer constituents include carbon, nitrogen, oxygen and/or silicon.
3. Tar, amber and horns are the easiest examples of synthetic polymers.
4. Plastics both conserve and produce energy.
5. Polymers do not conduct electricity and heat.
6. All polymers are divided into two distinct groups: thermoplastics and thermostatics.
7. Unwanted thermoplastics should be recycled.
8. Bakelite and phenolic resin produce heat energy when they are incinerated.

4.4 Activity

4.4.1 Comment on the following statement, using information of the text "Plastics"

"The usefulness of plastics can only be measured by our imagination. These are definitely the materials of past, present, and future generations."

4.4.2 Render information of the theme according to the following plan

1. Metals and non-metals in engineering.
2. Copper – main characteristics, advantages and peculiarities.
3. Steel and steel alloys.
4. Plastics, their role in the human life.

5 Additional texts for reading

Text "Branches of Engineering"

Engineering is a very practical activity. It is the process of applying the latest achievements of science and technology into practice.

There are a lot of branches in engineering. Mechanical engineers are experts in the design and manufacture of tools and machines. Mechanical engineering has marine, automobile, aeronautical, heating and ventilating branches.

Electrical engineering deals with producing and applying electricity in various fields of national economy. It has the following branches: electrical installation, electrical generation, lighting, etc.

Components and equipment for computing and communicating are the products of electronic engineering. Civil engineering deals with constructing bridges, roads and airports.

Text "SI Units"

The amount of electricity which is flowing (it is called the current) is measured in units called amps. The pressure of electricity, the voltage, is measured in volts. A unit of resistance is called an ohm.

Current, voltage and resistance have a definite relationship to one another. The current and the voltage determine the power, the rate at which electrical energy is used. A unit of power is a watt.

In System International (SI) there are seven base units. They are the following:

-the metre (m) as the unit of length;
-the kilogram (kg) as the unit of mass;
-the second (s) as the unit of time;
- the ampere (A) as the unit of electric current;
- the kelvin (K) as the unit of (thermodynamic) temperature difference;
-the mole (mol) as the unit of substance;
-the candela (cd) as the unit of luminous intensity.

All other SI units are derived from the seven base units. They are the joule, the watt, the pascal, the newton and, most interestingly, the unit of change, the coulomb.

Text “Capturing Energy from the Sun”

Solar energy can be collected in three main ways: photovoltaic (PV) coyer cells, solar collectors and solar furnaces. The first are used to convert sunlight directly into electricity. They are known to be first introduced in 1958 in order to power satellites in space. Now the cells seem to run everything from lighting systems to water pumps not to mention pocket calculators. At the Sydney Olympic village more than 8,000 photovoltaic panels that cover over 6,000 square metres provide 650 kilowatts of electricity. All houses in the Olympic village have PV cells built into the roof, to make the most of sunlight that falls on them.

Hot water for the village is supplied by solar thermal heating systems. Such systems include solar panels on the roof and large solar collectors. These are normally dark in order to absorb more sunlight. Their surface is covered with glass to let in the rays but hold heat. The heat is transferred to water, which runs through small pipes. The hot water is then circulated through the house. Solar thermal heaters are believed to reduce water-heating costs by about 50 % as some still use natural gas as a back up on cloudy days. It is estimated that 40 million solar heated buildings will be constructed in the near future.

Solar furnaces use a huge array of mirrors to concentrate the Sun's energy into a small space and achieve temperatures up to 33,000°C. They are likely to be used for scientific experiments but they are also known to generate electricity.

Text “The Photovoltaic Effect”

In 1839, a French scientist Edmond Becquerel was reported to discover the photovoltaic (PV) effect. 'Photovoltaic' means turning light into electricity. PV cells work like leaves of a tree. Leaves convert the Sun's energy into chemical energy during photosynthesis. Similarly, PV cells capture the sunlight and turn it into electrical energy.

The materials used to make PV cells are called semiconductors. They are likely to be made from silicon. This is a very plentiful material - in fact, every grain of sand is estimated to contain silicon in the form of silicon dioxide, SiO_2.

How a PV cell works. When photons (tiny, individual packets of light energy) strike a cell, some are absorbed. Each transfers its energy to an electron in an atom. The electron now has enough energy to break free of its atom and can move away. The cells are made in two layers, one is more positively charged than the other. The negatively charged electrons move towards the positive layer. Thus, an electric current is formed.

Text “Solar-powered Cars”

One of the ways we can reduce the amount of pollution from traffic seems to power our vehicles using renewable resources. To demonstrate this, the World Solar Challenge Car Race from Darwin to Adelaide annually involves dozens of cars that are powered only by the energy of the Sun. The cars are reported to use photovoltaic (PV) cells to convert sunlight into electricity. A single PV cell is known to produce only a small amount of electrical power (approximately 0.5

volts). To increase the power, lots of PV cells are connected together to make a 'solar panel'. Panels can be linked to form a large solar array that is certain to produce enough electricity to power a car.

When the World Solar Challenge teams design their electrical systems, they have to take into account variations in the intensity of sunlight. The Sun's energy is supposed to power the car's motor and also charge a battery for use at night or at times when the Sun is hidden by a clouds. If a car is designed to put all its energy toward driving and keeps nothing in reserve, it is sure to stop completely in cloudy weather. If too much energy is diverted to the battery, the engine is found to run too slowly.

Engineers still have many questions and problems to tackle before solar power becomes an efficient and economical way to fuel vehicles. Today's solar-powered cars are rather expensive but as the pressure on fossil-fuel resources is certain to increase scientists will continue to search for alternative energy sources, including harnessing the Sun's energy to drive vehicles. The most fascinating part of using solar power as an energy source is that it is considered to be pollution-free and inexhaustible. If research continues, stopping for petrol is likely to become a thing of the past.

Do you know that...

...copper is essential to our health as an important constituent of skin, bones and blood. It is also biostatic — bacteria cannot grow on its surface. High-tech doctors save lives with the help of copper-clad scalpels.

...a copper plumbing system from the Pyramid of Cheops in Egypt is still in a serviceable condition after more than 5,000 years.

...copper has always been part of metal money.

...chefs around the world prefer copper cookware due to its properties of high heat transfer plus uniform heating (no hot spots).

...copper is the standard for electrical conductivity. It conducts electrical current better than any other metal except silver.

...IBM is replacing aluminium with copper in computer chips - up to 200 million transistors can be packed onto such a chip. The result is much faster operating speeds.

...about 2 % (9,000 pounds) of the total weight of a Boeing 747-200 jet plane is copper. A typical diesel-electric locomotive uses about 11,000 pounds of copper while a Triton-class nuclear submarine uses about 200,000 pounds of copper.

...yellow brass (Copper Alloy 360) is so easy to machine, that it is the standard for metals machinability.

...high-strength, nonmagnetic and corrosion-resistant copper alloy tools are also nonsparking, which is valuable in situations where explosions are feared.

...designers look at copper and brass as metals of quality, comfort and beauty.

...through one hundred years of sea winds, rains and sun, the copper skin of the Statue of Liberty not only has become more beautiful but also has remained virtually undamaged. Closer analysis shows that weathering and oxidation of the copper skin has come to just 0.005 of an inch in a century.

...copper clearly was a good idea a hundred years ago. With technological advances, copper is still a great idea today.

Text "Steel Quality"

In order to understand tool quality, remember that steel is basically iron with a carbon content of l.7 percent or less. Adding carbon makes the metal harder, but also more brittle, less malleable and less resistant to stress and shock. As tools differ, steel is matched with suitable carbon content for each tool. Tool quality steel must have at least 0.6 % of carbon content. This insures that the steel can be heat-treated. Traditionally, heat treating involves heating the metal to about 1,350 F and then plunging it in to cool water. This abrupt cooling technique called quenching; changes the carbon particles in the metal into hard carbide crystals. Heat treating produces a hard edge on tools. However, it only penetrates about 1/8 into the metal and thick tools retain a soft center. Obviously, the quality of each tool depends on the skill of the smith, but many old tools are still in use today. These 'water-hardened steel' tools are made of carbon steel and hold a very keen edge. Yet, they have two serious drawbacks. These tools tend to rust easily and to lose their temper and edge at high temperatures: e.g. carbon-steel drill bits will dull quickly when used in an electric drill; a carbon-steel turning chisel, for use on a lathe, loses its edge when subjected to the friction of the rotating wood.

In order to make better steel, metallurgists experiment with various alloy ingredients. For example, adding tungsten or molybdenum results in high-speed steel resisting a great heat buildup. When buying drill bits, be sure to look for ones made of high speed steel. Chromium and nickel make steel stainless or rustproof. Early stainless steel knives had one major drawback however; they could not hold a sharp edge the way carbon steel knives could. Chefs and serious cooks preferred carbon steel knives (even though they were prone to rusting) for this reason. Metallurgists gradually improved the quality of stainless steel having developed a grade for cutlery that is rust-resistant and can hold a keen edge.

In addition to creating alloys, manufacturers also improve the techniques of steel making. They have developed special heat-treating ovens and slow-quenching methods so that temper and hardness could be accurately controlled.

Text "The Runs of Steel"

Ancient metal smiths realized that tools would last longer if the hard shell could somehow be inserted in the core of the metal. In Damascus they developed the technique of folding the metal again and again, then hammering it into a solid piece of laminated steel. This method was so successful that Damascus steel became prized throughout the ancient world. The lamination technique was perfected to manufacture samurai swords and continues today in tool making in Japan. However, the Damascus process took time. Each piece had to be tested for quality and there were many rejects. The process was eventually replaced by a less complicated technique. The smith shaped the tool, heated it in the forge, and then quenched it. By carefully limiting the thickness of the tool, the blacksmith could create a tool with the right combination of toughness and hardness.

Are modern tools superior to those of past generations? In general - yes, but there are cheap exceptions. Such tools are case-hardened so that the hard exterior is only a fraction of an inch thick. When the tool is sharpened, the hard exterior is ground off; and the tool cannot hold an edge. Some tools look like stainless steel, but they are only nickel-plated. As soon as the plating wears off, the tool begins to rust. You get what you pay for. When it comes to tools, it pays to buy good quality products.

Text "Sports Materials"

Materials engineering is the study of materials - anything from tennis racket frames to turbine blades in aero engines. The subject combines sciences with engineering and looks at the structure of materials, their properties and fabrication.

Materials science has a dramatic impact on sporting records. Since 1896 the Olympic record in the pole vault, for example, has increased from 3 to about 6 metres largely due to the changes in materials technology. The first poles were made from solid hickory wood. In 1904 bamboo poles were introduced, which only 50 years later were replaced by aluminium poles. The latter, however, gave little improvement in performance and had to be replaced by lighter and less stiff glass-fibre composites. These account for the dramatic increase in performance.

The materials and design of hockey sticks have also changed a lot. Hockey sticks used to be made from wood, and they failed quickly. Modern hockey sticks are made from carbon-fibre and glass-fibre composites, which increase stiffness. As the failure can be dangerous, researchers still have to improve the performance of composite sticks.

Early tennis rackets were made from solid wood (ash or maple). Because of its cellular structure, wood is anisotropic, i.e. its properties are not the same in each direction. This limited the size and stiffness of the rackets. The anisotropy was overcome by the introduction of wood laminates, but there was still the problem of water absorption, which caused the deformation of the racket. In the 1970s aluminium alloy frames were introduced. The greater stiffness of the aluminium meant that frames could be lighter. However, these were soon replaced by even stiffer and lighter carbon-fibre rackets. The research continues and materials engineers have not said their last word yet.

6 Glossary of terms

Bulb, n - лампочка
Capacitor, n - конденсатор
Cell, n – батарейка, (фото) элемент
Charged, adj - заряженный
Circuit, n – цепь
Closed circuit – замкнутая цепь
Condenser, n - конденсатор
Current, n - ток
Direct current – прямой ток
Alternating current – переменный ток
Dielectric, n - непроводник
Filament, n – нить накала
Frequency, n - частота
Grid, n – энергетическая сеть
Transmission grid – сеть электропередач
Insulator, n – изолятор, непроводник
Power, n - энергия
Power plant
Thermal power – термическая энергия
Nuclear power – ядерная энергия
Underground steam power – энергия подземного пара
Solar power – солнечная энергия
Kinetic power – кинетическая энергия
Chemical power – химическая энергия
Rectifier, n - выпрямитель
Socket, n – патрон, розетка
Transformer, n - трансформатор
Step-up transformer – повышающий трансформатор
Step-down transformer – понижающий трансформатор
Winding, n - обмотка
Input winding – output winding – входная обмотка – выходная обмотка
Primary winding – secondary winding – первичная обмотка – вторичная обмотка
Voltage, n - напряжение
Wire, n - провод

Amplification, n – усиление
Amplifier, n – усилитель
Bounce, v – отскакивать
Cavity, n – полость
Coherence, n – когерентность
Concave, adj – вогнутый
Continuous, adj - непрерывный
Device, n – устройство, прибор

Directionality, n - направленность
Flash, n - вспышка
Inversion, n - инверсия
Population inversion – инверсия заселенности (энергетических уровней)
Medium, n - среда
Monochromicity, n – одноцветность, монохромность
Oscillator, n – генератор, осцилятор
Transparent, adj - прозрачный
Via, prep – через, посредством
Wavelength, n – длина волны
Welding, n - сварка

Alloy, n - сплав
Aluminium, n - алюминий
Carbon, n - углерод
Ceramics, n – керамика, гончарное производство
Conductivity, n - проводимость
Electric conductivity – электропроводимость
Heat conductivity - теплопроводимость
Copper, n - медь
Fabrication, n - изготовление
Flexibility, n - плавкость
Ferrous, adj – черный, не цветной (о металле)
Hydrogen, n - водород
Iron, n - железо
Cast iron - чугун
Manganese, n - марганец
Nickel, n - никель
Non-ferrous, adj - цветной
Plastic, n, adj – пластмасса, пластик; пластмассовый
Plasticity, n - пластичность
Resistance, n - сопротивление
Corrosion resistance - коррозиеустойчивость
Rubber, n – каучук, резина
Silicon, n - кремний
Steel, n - сталь
Sulphur, n - сера
Tin, n - олово

Engineering, n – техника, конструирование, строительство
Civil engineering – гражданское строительство
Mechanical engineering - машиностроение
Power engineering – энергетическое строительство
Electrical engineering – электро–техническое строительство
Electronic engineering - электроника

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