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Учебное пособие предназначено для студентов, обучающихся по направлению 16.03.01 «Техническая физика» и включает в себя аутентичные тексты по актуальным проблемам физики, инженерии и современных технологий, практические задания, направленные на создание необходимого лексического запаса, развитие навыков чтения специальной литературы, перевода специальных текстов, устной и письменной речи.

Содержание практических материалов пособия способствует освоению и закреплению специальной терминологии, совершенствованию коммуникативных навыков, формированию лингвистической культуры и профессиональной иноязычной компетенции студентов. Материал может быть полезен студентам других инженерно-технических направлений подготовки и специальностей.

Пособие создано в соответствии с требованиями программы по английскому языку для неязыковых специальностей высших учебных заведений.

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ПРЕДИСЛОВИЕ

Учебное пособие разработано с учетом требований Государственного стандарта высшего профессионального образования. Настоящее пособие предназначено для студентов первого и второго курсов, обучающихся по направлению «Техническая физика» и содержит аутентичные и авторские материалы, а также ряд практических заданий по английскому языку для специальных целей (ESP). Пособие составлено на основе проанализированного и переработанного аутентичного и авторского материала с учетом и в обьеме меняющихся требований по программе дисциплины «Иностранный язык» для неязыковых специальностей высших учебных заведений и может быть рекомендовано к использованию, как для аудиторной, так и самостоятельной работы.

Целью пособия является овладение студентами компетенциями устного и письменного профессионально-ориентированного общения на английском языке. В задачи пособия входит развитие навыков и умений самостоятельно работать с аутентичными текстами на английском языке.

Пособие состоит из шести модулей, отражающих основные разделы технической физики, механики, инженерии, электроники, информационных технологий, нанотехнологий и ряда других аспектов; дополнительного чтения, где представлены материалы научных текстов, статей и т.д. по современным техническим и инженерным проблемам; приложения.

Модули состоят из блоков, которые содержат тексты для изучающего чтения, упражнения на отработку и закрепление новой лексики, словообразование, умение оперировать терминами, отработку навыков устного и письменного перевода, монологической и диалогической речи. Ряд упражнений предполагает творческое участие студентов и представлены в форме презентаций, докладов.

Приложение содержит методические указания и клише для составления аннотаций текстов и статей, а также по составлению презентаций с разделением на этапы и предложением используемых клише на английском языке.

Contents

UNIT 1. MECHANICS AND MECHANICAL ENGINEERING

Text 1.

THE SUBJECT OF MECHANICS

PRE-READING

1. Answer the following questions.

1. What facts about Mechanics do you know?
2. What does Applied Mechanics mean?

2. Practice reading the following words.

quantum	[ˈkwɒntəm]	axiom	[ˈæksɪəm]
mechanics	[mɪˈkanɪks]	techniques	[tekˈniːks]
occur	[əˈkɜː]	measurement	[ˈmeʒəm(ə)nt]
mathematization	[mæθiˌmæti'zeiʃən]	molecule	[ˈmɒlɪkjuːl]

VOCABULARY

3. Study and remember the words.

dynamics	динамика
direction	направление
treat	определять
entirely	полностью
concept	концепция
mathematize	математизировать
probability	вероятность
design	разработка
aircraft	летательные аппараты
missile	снаряд, ракета
satellite	спутник

current	океаническое течение
forecast	прогнозировать

READING

4. Read the text and answer the questions.

THE SUBJECT OF MECHANICS

Mechanics was born at the dawn of civilization. As a science, mechanics deals with the motion of masses and the effect of forces in causing or modifying these motions.

Classical mechanics can be divided into statics and dynamics. Statics studies bodies at rest, or in motion at a constant speed and in a constant direction. Dynamics is the study of bodies that undergo a change of speed or direction, or both, because of forces acting upon them.

There are three branches in mechanics:

1) statics which deals with forces acting on and in a body at rest;

2) kinematics describes the possible motions of a body or a system of bodies;

3) kinetics attempts to explain or predict the motion that will occur in a given situation.

During the 100 years following Newton's death, the development in mechanics was due to its progressive mathematization. In 1788, Louis Lagrange published his “Mećhanique analitique”, which treated mechanics as a branch of mathematics, arising from a few axioms and developed entirely by analytical mathematical techniques. Mechanics has continued to be a branch of mathematics, but it also returned to its roots in physics in the 19th century. Andrée-Marie Ampére used experiment to discover aspects of electrical science that could be treated by mechanical mathematics. The kinetic theory of gases provided new physical measurements and concepts that could be mathematized and handled by mechanics. But here individual bodies or elements could no longer be treated as it was impossible to follow an individual gas molecule. Instead,

large groups were the subject of mechanical operations, and statistical mechanics was born.

All this work was done within the Newton's framework, which proved too narrow by the beginning of the 20th century. In the 1920s a special mechanics called quantum mechanics was devised to deal with subatomic particles. This mechanics is completely mathematical: it consists of the mathematical computation of the probability of making a physical measurement.

In the ordinary world Newtonian mechanics still holds and serves to direct everything from the design of new automobiles and aircraft to the navigation of intercontinental ballistic missiles and satellites. Mechanics helps further progress in many scientific and engineering fields. Its achievements are used to create new machines and aircrafts, calculate the orbits of spaceships, study ocean currents and forecast the weather.

QUESTIONS:

1. What does mechanics study?
2. What are the two main types of mechanics?
3. How many fields does mechanics have? Could you name them?
4. What scientists made a great contribution to the development of mechanics?
5. What does the kinetic theory of gases provide?
6. How could you explain contribution of mechanics to new technologies?

VOCABULARY WORK

5. Find English equivalents to the following word combinations in the text.

1) Обычный мир;
2) дальнейший прогресс;

3) отрасль математики;

4) классическая механика;

5) физическое измерение;

6) система тел;

7) предсказать движение;

8) субатомные частицы;

9) математическое вычисление;

10) полностью разработана

6. **Find the synonyms to the following words in the text.**

1) Field;

2) happen;

3) fully;

4) driven by;

5) back to;

6) introduced;

7) fully developed;

8) at the beginning of;

9) is made up of;

10) test

7. **Insert the necessary word in the gap.**

1) Mechanics has its roots in several … civilizations.

a) ancient

b) American

c) European

d) medieval

2) … is a continuous change in position of a body.

a) Braking

b) Fall

c) Motion

d) Clutch

3) … is the study of fluids at rest.

a) Hydraulics

b) Hydromechanics

c) Hydrostatics

d) Hydroengineering

4) … discovered three basic laws of motion.

a) Euler

b) Galilei

c) Euclid

d) Newton

5) The first combustion engine was built by Samuel Brown in England in …

a) 1823

b) 1835

c) 1900

d) 1821

8. **Mark true (T) or false (F) sentences.**

1. Mechanics is a modern science.
2. There are three branches in mechanics.
3. Louis Lagrange published his "Meċhanique analitique" in 1788.
4. Mechanics is a branch of mathematics and physics.
5. Andrée-Marie Ampére used experiment to discover aspects of optical science that could be treated by mechanical mathematics.
6. The kinetic theory of gases provided new physical measurements and concepts that could be mathematized and handled by mechanics.

7. . In the 1930s a special mechanics called quantum mechanics was devised to deal with subatomic particles.
8. Mechanics consists of the mathematical computation of the probability of making a physical measurement.
9. Newtonian mechanics still serves to direct everything from the design of new automobiles and aircraft to the navigation of satellites.
10. Mechanics helps further progress in many scientific and engineering fields.

9. **Suffixes are used to form different parts of the speech. Use your dictionary to find the derivatives of the words. Translate the words into Russian.**

   Physics – physical, …

   Science –

   Mechanics –

   Engine –

   To define –

10. **In pairs, take turns to interview your partner about understanding the subject of Mechanics. What questions do you think are the most relevant?**
11. **Retell the text.**

COMPREHENSION

12. **Read the text about M. Lomonosov and make up questions to it**

MIKHAIL LOMONOSOV (1711—1765)

Mikhail Lomonosov was born in the family of a fisherman in the northern coastal village of Denisovka not far from Archangelsk. When he was ten years of age his father began to take him sea fishing. The dangerous life of a fisherman taught him to observe the natural phenomena. During the long winter nights young Lomonosov studied grammar and arithmetic diligently.

As he was the son of a peasant, he was refused admission to the local school. Some years later, through concealing his peasant origin, Lomonosov managed to

enter the Slavonic-Greek-Latin Academy and for five years lived a hand-to-mouth existence on three kopecks a day. The noblemen's sons studying with him made fun of the twenty-year- old giant who, in spite of his poverty, made rapid progress.

Lomonosov's ability and diligence attracted attention of the professors and as one of the best students he was sent abroad. He spent all the time there studying the works of leading European scientists in mathematics, mechanics, physics, chemistry, metallurgy and mining. On his return to Russia in 1745 he was made a professor and was the first Russian scientist to become a member of the Academy of Sciences.

A scientist of encyclopedic knowledge, he was the founder of modern research in Russia in very many fields. In physics Lomonosov was the first scientist to explain thermal phenomena in terms of the atomic and molecular theory. At the same time as Franklin, he demonstrated the electric nature of lightning and invented the lightning rod.

He also made outstanding discoveries in astronomy — he detected the atmosphere of Venus and described the substance of comet tails. Lomonosov also did a great deal in metallurgy and mining, glass- making and pyrotechnics. He made forty mosaic panels and portraits in his studio. His best work is a portrait of Peter the Great, which is on display at the Hermitage Museum in St. Petersburg.

His living memorial is the Moscow University, which he founded in 1755. And our greatful country will always remember Lomonosov, who, in Pushkin's words, was a "whole university" in himself.

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13. **Translate the following text into English. What is the main idea of the text?**

Механика – раздел физики, в котором изучается движение тел под действием сил. Механика охватывает очень широкий круг вопросов – в ней рассматриваются объекты от галактик и систем галактик до мельчайших, элементарных частиц вещества. В этих предельных случаях выводы механики представляют, конечно, чисто научный интерес. Но предметом механики является также проектирование строений, мостов и механизмов; этот раздел, обычно называемый прикладной механикой, сам по себе достаточно обширен. Фундаментальное значение для всей этой тематики имеет механика материальной точки, разделяющаяся на кинематику, предметом которой является математическое описание возможных движений материальной точки, и динамику, которая рассматривает движение материальных точек под действием заданных сил. Основные принципы динамики сведены в законы движения, которые в случае материальных точек имеют самый простой вид. Эти законы были впервые сформулированы в 1687 И. Ньютоном. Если материальные точки движутся с очень большими скоростями, то ньютоновские законы движения следует модифицировать в соответствии с теорией относительности; если же это частицы атомных масштабов, то необходима иная формулировка законов движения – так называемая квантовая механика. Протяженное тело можно формально рассматривать как совокупность идеализированных материальных точек, совершенно не имея в виду атомное строение вещества. Выводы о движении таких тел можно делать, исходя из совокупности движений материальных точек. Здесь тоже проводится различие между кинематикой и динамикой и, кроме того, существует статика, изучающая условия равновесия твердых тел, на которые действуют внешние силы.

Text 2.

MECHANICAL ENGINEERING

PRE-READING

1. Answer the following questions.

1. What is a definition of mechanical engineering?

2. What do you think about the ways of development of the study?

1. Practice reading the following words.

thermodynamics	[ˌθɜːməʊdaɪ'næmɪks]
fatigue	[fə'tiːg]
cycle	['saɪk(ə)l]
drawing	['drɔːɪŋ]
dimension	[d(a)ɪ'menʃ(ə)n]

VOCABULARY

2. Study the vocabulary list.

maintenance	обслуживание
motor vehicle	автомобиль
watercraft	водный транспорт
matter	материя
acceleration	ускорение
frame	рама
load	нагрузка
stress	напряжение
phases of engineering	этапы проектирования
structural engineering	строительная инженерия

push the boundaries	раздвигать границы

READING

3. Read the text and answer the questions.

MECHANICAL ENGINEERING

Mechanical engineering is an engineering discipline that involves the application of principles for analysis, design, manufacturing and maintenance of mechanical systems. It requires understanding of key concepts including mechanics, kinematics, thermodynamics and energy. Mechanical engineers use these principles in the design and analysis of motor vehicles, aircraft, heating and cooling systems, watercraft, manufacturing plants, industrial equipment and machinery, medical devices, etc.

The field of mechanical engineering is a collection of many mechanical disciplines.

As we know, mechanics is, in the most general sense, the study of forces and their effect upon matter. Generally, engineering mechanics is used to analyze and predict the acceleration and deformation (both elastic and plastic) of objects under known forces (also called loads) orstresses. Mechanical engineers typically use mechanics in the design or analysis phases of engineering. If the engineering project is the design of a vehicle, they employ statics to design the frame of the vehicle, in order to evaluate where the stresses will be most intense. Dynamics is applied when designing the car's engine, to evaluate the forces in the pistons and cams as the engine cycles. Mechanics of materials may be used to choose appropriate materials for the frame and engine. Fluid mechanics is used to design a ventilation system for the vehicle or to design the intake system for the engine.

Structural engineering is the branch of mechanical engineering devoted to examining why and how objects fail. Structural failures occur in two general

modes: static failure and fatigue failure. Static structural failure occurs when the object with the applied force breaks or is deformed plastically. Fatigue failure takes place when an object fails after a number of repeated loading and unloading cycles. Fatigue failure occurs because of imperfections in the object: a microscopic crack on the surface of the object, for instance, will grow slightly with each cycle until the crack is large enough to cause ultimate failure. Structural analysis is often used by mechanical engineers after a failure has occurred, or when designing to prevent failure.

Thermodynamics is an applied science used in several branches of engineering, including mechanical engineering. Thermodynamics is the study of energy, its use and transformation through a system. Engineering thermodynamics is usually concerned with changing energy from one form to another. As an example, automotive engines convert mechanical energy from the fuel into heat, and then into mechanical work that turns the wheels.

Drafting or technical drawing is the means by which mechanical engineers create instructions for manufacturing parts. A technical drawing can be a computer model or hand-drawn scheme showing all the dimensions necessary to manufacture a part, as well as assembly notes, a list of required materials and other information.

Mechanical engineers are constantly pushing the boundaries of what is physically possible in order to produce safer, cheaper and more efficient machines and mechanical systems.

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QUESTIONS:

1. What is mechanical engineering?
2. What key concepts must a mechanical engineer understand?
3. What disciplines does mechanica1 engineering include?

4. When should mechanical engineers use the knowledge of statics?
5. In what cases do they employ their knowledge dynamics?
6. Where is fluid mechanics used?
7. What does structural engineering mean?
8. What are the main modes of structural failures?
9. What is thermodynamics and where is it applied?
10.By what means do mechanical engineers create instructions for their machinery?

VOCABULARY WORK

4. Translate the following word combinations into Russian.

1. Manufacturing plants;
2. key concepts;
3. motor vehicles;
4. aircraft and watercraft;
5. heating and cooling systems;
6. industrial equipment;
7. effect of forces upon matter;
8. to predict the acceleration;
9. engine cycles;
10. intake system.

5. Find English equivalents to the following word combinations in the text.

1. Машинное оборудование;
2. в самом общем смысле;
3. поршни и кулачковые диски;
4. гидромеханика;
5. поломка конструкции;
6. усталостное разрушение;

7. окончательная поломка;
8. техническое проектирование;
9. предотвращать поломку;
10. преобразовать энергию.

6. Match the following words with definitions and translate them into Russian.

1. Manufacture	a. any device for carrying persons or objects over land or in space.
2. Maintenance	b. mechanisms.
3. Vehicle	c. the tendency of a material to crack and fail under repeated application of stress.
4. Machinery	d. creating instructions for manufacturing parts.
5. Failure	e. a person who makes plans of structures or machinery.
6. Static failure	f. the making of goods or articles by machinery on a large scale and with the division of labour.
7. Fatigue	g. a breakdown in operation or function.
8. Drafting	h. the work of keeping machinery in a state of good repair.
9. Draftsman	i. any material burned to supply heat or power.
10.Fuel	j. plastic deformation or breaking under the action of an applied force.

7. Find out the key words of the text.

8. Use the key words of the text to make up the outline of the text.

9. Write out the main idea of the text. Be ready to speak about it.

10. Give the summary of the text.

COMPREHENSION

11. Read the text and find the answers to the following questions.

I. When and where was Newton born?

2. Where did he study?

3. What three major discoveries did Newton make?

4. When did Newton make these discoveries?

5. How did the idea which led to the discovery of the law of gravitation first come to him?

6. When did Newton die and where is he buried?

ISAAK NEWTON (1642-1727)

Newton, one of the greatest scientists of all times was born in 1642 in the little village in Lincolnshire, England. His father was a farmer and died before Newton was born. His mother was a clever woman whom he always loved.

After the school, Newton studied mathematics at Cambridge university and received his degree in 1665. Then the university was closed because of the danger of plague and Newton went home for eighteen months. It was most important period in his life when he made his three great discoveries – the discoveries of the differential calculus, of the nature of white light, and of the law of gravitation.

These discoveries are still important for the modern science. Newton had always been interested in the problems of light. Many people saw colours of a rainbow but only Newton showed, by his experiments, that white light consists of these colours.

It is interesting how he discovered the law gravitation. Once, as he sat at the garden, his attention was drawn by the fall of an apple. Many people saw such an usual thing before. But it was Newton who asked himself a question: “Why does that apple fall perpendicularly to the ground? Why doesn’t it go sidewards or upwards?” The answer to this question was the theory of gravitation, discovered by Newton.

Newton died at the age of 84, and was buried in Westminster Abbey, where his monument stands today.

Downloaded from Isaak Newton URL: : https://englishtopic.ru/isaac-newton-isaak-nyuton/

12. Translate the following text into Russian.

INTERNAL COMBUSTION ENGINES

The first internal combustion engine light enough in weight was the gasoline engine, invented by a German named Otto.

At the same time Dr. Rudolph Diesel was working on the diesel engine. The Diesel engine is similar to the gasoline engine in many ways. There are many variations in engine arrangements, but the basic parts of most 4-stroke cycle engines are similar. .In the in-line arrangement the cylinders are lined up in a single row. The V-type engine is called so as the cylinders form 2 rows or "banks", set at an angle to each other to form the letter V.

The diesel engine gets its power from the expansion of burning gases. The diesel engine depends on the heat of compression for ignition of the fuel. Liquid fuel that contains more heat energy than gasoline is diesel oil. Diesel oil is slower burning, but it produces more power. Diesel engines also must be heavier than gasoline engines, but they are more efficient when working under heavy loads at low speeds.

Downloaded from Internal Combustion Engines.
URL:https://ru1.ilovetranslation.com/_MvDGLA-A_v=d/

SPEAKING

13. Find more information in the Internet and continue the idea:

Issues of modern mechanics are … .

Be ready to speak about 3 minutes.

14.Quiz "What do you know about Mechanics and Mechanical Engineering?" Ask and answer the questions with your partner. Make up dialogues.

1) What is mechanics
2) What do you understand by classical mechanics?
3) What does mechanics study?
4) What scientists laid the foundation of mechanics?
5) What is M. Lomonosov noted for??
6) What is mechanical engineering?
7) What disciplines does mechanica1 engineering include?
8) What is Newton's main discovery?
9) What should an engineer know to design a machine?
10) By what means do mechanical engineers create instructions for their machinery?

15. Make up the presentation about one of the physicists who made the great contribution in the field of Mechanics.

- Archimedes
- I. Newton
- G. Galileo
- M. Lomonosov

UNIT 2. ELECTRIC: ENGINEERING

Text 1.

ELECTRIC CHARGE. THE ELECTRIC FIELD

PRE-READING

1. Answer the following questions.

1. What phenomena made up ancient people's knowledge of electrical effects?

2. Could they explain those phenomena?

2. Practice reading the following words.

current	[ˈkʌrənt]	gravitation	[ˌgrævɪˈteɪʃən]
electromagnetic	[ɪˌlektrəʊmægˈnetɪk]	magnitude	[ˈmægnɪtjuːd]
phenomena	[fəˈnɔmɪnə]	measure	[ˈmeʒə]
surround	[səˈraʊnd]	oppositely	[ˈɔpəzɪtlɪ]
equipment	[ɪˈkwɪpmənt]	coulomb	[ˈkuːlɔm]
characteristic	[ˌkærəktə'rɪstɪk]	electrified	[ɪˈlektrɪfaɪd]
apparently	[ə'pærəntlɪ]	consideration	[kənˌsɪdəˈreɪʃn]

3. Read and think about the meaning of the following international words.

Static; electricity; electric; phenomena; coulomb; electrical force; conductor; insulator; grounding; electrified; gravitation; transferred.

VOCABULARY

4. **Study and remember the words.**

current	[ˈkʌrənt]	ток
charge	[tʃɑːrdʒ]	заряд
straw	[strɔː]	солома
device	[dɪˈvaɪs]	устройство

store	[stɔː]	хранилище
natural	[ˈnætʃrəl]	натуральный
force	[fɔːs]	сила
emanate	[ˈeməneɪt]	исходить
terminate	[ˈtəːmɪneɪt]	завершать
strength	[streŋθ]	прочность
originate	[əˈrɪdʒɪneɪt]	происходить
plate	[pleɪt]	пластина
direction	[dəˈrekʃn]	направление
magnitude	[ˈmægnɪtjuːd]	величина, значение
attract	[əˈtrækt]	притягивать
harness	[ˈhɑːnəs]	использовать
amber	[ˈæmbə]	янтарь

READING

5. Read the text and answer the questions.

ELECTRIC CHARGE

Key words: static electricity, electric charge, electric current, amber, coulomb, electrical force, electric field, field lines.

Electric charge, electric currents, batteries, and electromagnetic signals are so much a part of our daily lives that we barely notice them anymore. Most of the time, we are surrounded by electrical phenomena in both the natural world and the human-made world. We learned about the presence of electricity in the world through experimentation and observation, and we have learned how to harness, control, and store electrical power for our everyday use, as in the tiny batteries that power our watches and electronic equipment.

Long ago, Greek scientists discovered that a material called amber when rubbed with a cloth would attract small pieces of straw. In later centuries other materials were found to have this same characteristic. There was some property of the cloth that apparently was transferred to the amber when the two were rubbed together, and that property enabled the amber (for a brief time) to attract small pieces of straw. The amber had been *electrified.*

Electrostatics studies the nature of charge that is not moving, and set the stage for a consideration of moving charge that is needed to understand the electrical circuits in all the electronic devices that we use every day.

THE ELECTRIC FIELD

The electrical force, like gravity, can act between objects that are not physically in contact. In fact, any two charged particles will exert forces on each other; but even a lone charged particle is surrounded by what we call an *electric field* that is a direct result of its net charge.

The electric field (like the gravitational field of an object with mass) has both a magnitude and a direction; that is, it is a vector quantity.

The electric field is measured in units of force per unit charge, so that a charge q that experiences a coulomb force F is in an electric field of strength

$E = F/q$

where F is the coulomb force and q is the charge of the particle.

Because the electric field represents a vector quantity, we can draw *field lines* that represent: the motion that a positively charged particle would take if it were nearby. For this reason, positively charged particles have field lines emanating from them, and negatively charged particles have field lines that point toward them.

Electric field lines are always drawn as though they originate at positive charges terminate at negative charges. Figure 1 shows examples of field lines around a positive charge, a positive and a negative charge, and two oppositely charged plates.

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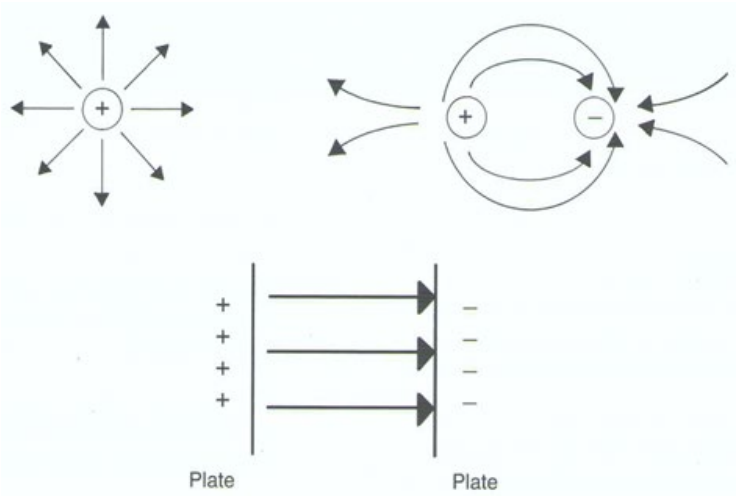

Figure 1

QUESTIONS:

1) How did people discover electricity?

2) What materials did Greek scientists use in the first electrostatics experiments?

3) What does electrostatics study?

4) In what way is electric force similar to gravity?

5) What is the nature of electric field?

6) What are the units of measurement of electric field?

7) Where are field lines directed in electric field?

VOCABULARY WORK

6. **Match the words similar in meaning.**

1. vector	a. use
2. always	b. substance
3. harness	c. every time
4. emanate	d. direction
5. material	e. radiate
6. property	f. evidently
7. apparently	g. pass

8. transfer	h. feature

7. Match the words opposite in meaning.

1. line	a. staying
2. moving	b. start
3. attract	c. dot
4. terminate	d. accept
5. transfer	e. repel
6. natural	f. long
7. presence	g. artificial
8. brief	h. absence

8. Find English equivalents to the following word combinations in the text.

1. электрическое поле
2. представлять собой векторную величину
3. прямой результат
4. электронные устройства
5. часть нашей повседневной жизни
6. кулоновская сила
7. природа неподвижного заряда
8. может действовать между объектами
9. наличие электричества
10. объект с массой
11. происходит в положительных зарядах
12. положительно заряженная частица
13. противоположно заряженные пластины

9. Reorder the words to make a sentence.

1. forces, will, any, In fact, exert, two, other, charged, particles, on, each.

2. the, quantity, electric, represents, Because, a vector, field.

3. a direction, The, field, electric, has, a magnitude, both, and .

4. watches, The, batteries, tiny, power, our, electronic, and, that, equipment.

5. been, The, electrified, had, amber.

10. Match the following terms with definitions and translate them into Russian.

1. gravity	a. directed segment, that is the segment that has shown the beginning (also called point of application) and an end
2. vector	b. the large size or importance of something
3. magnitude	c. the force that attracts objects towards one another, especially the force that makes things fall to the ground
4. property	d. an object that provides electricity for things such as radios, toys, or cars
5. battery	e. a quality of something

11. Suffixes are used to form different parts of the speech. Use your dictionary to find the derivatives of the words. Translate the words into Russian.

To resist – resistance …

To conduct – …

To insulate, – …

To discover. – …

12. In pairs, take turns to interview your partner about understanding what electric charge and the electric field is. What questions do you think are the most relevant?

13. Use the key words of the text to make up the summary.

COMPREHENSION

14.Read the text and find the answers to the following questions.

1. What is called resistance?
2. What does the resistance of a material depend on?
3. What materials are called superconductors?
4. What is an electrical circuit?
5. What relationship among current, voltage, resistance in a circuit did Ohm discover?
6. What is the unit of resistance the equivalent of?
7. What doubles the current?

RESISTANCE AND OHM'S LAW

Almost all materials resist the flow of current to some degree. Electrons move more easily through some materials than they do through others. Conductors allow electrons to pass more easily than do insulators.

The tendency for certain materials to slow the passage of electrons is called its *resistance.* Resistance is measured in ohms [abbreviated with the Greek letter omega (Ω)] after the German physicist Georg Simon Ohm (1787-1854). The resistance of a material depends on its atomic structure (metals, for example, allow electrons to pass easily through their lattice structure) as well as its temperature. Raising the temperature of materials produces more random motion in their electrons, and this random motion keeps current from flowing easily. Conversely, lowering the temperature of materials can reduce their resistance, allowing current to flow more easily. There are even materials, called *superconductors,* that at sufficiently low temperatures have almost no resistance to the flow of electricity.

An *electrical circuit* is any pathway that allows electrons to flow. Simple circuits can involve very few elements. A flashlight is a simple circuit, involving only an emf (the battery) a resistor (the bulb). Figure 1 shows a diagram of this simple electrical circuit.

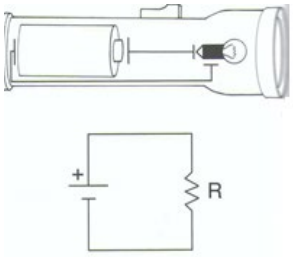

Figure 1. A Flashlight and its Equivalent Circuit

Georg Ohm is also credited with discovering the relationship among current, voltage, resistance in a circuit. He found by experiment that the current in a circuit is directly proportional to the applied voltage (the emf), and is inversely proportional to the resistance. We can write this relationship, called *Ohm's law*, as

$I = V/R$

where I is the current (in amperes), V is the voltage (in volts), and R is the resistance (in ohms). Therefore, the unit for resistance, the ohm, is the equivalent of volts per ampere, or $1\ \Omega = 1\ V/A$.

Thus, doubling the voltage of a circuit (while keeping resistance the same) doubles the current. Halving the resistance of a circuit (while keeping voltage the same), also doubles the current.

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15. Translate the following text into Russian.

RHEOSTAT

A rheostat is a resistor whose resistance value may be varied. Thus, a rheostat is a variable resistor. It is used to change the resistance of circuits, and in this way to vary the value of current. A rheostat consists of a coil and a switch. Take into consideration that wire used for the coil must have a very high resistance. When a rheostat is used its terminals are connected in series with the load. The switch is used to change the length of the wire through which the measured current passes. The resistance may be changed to any value from zero to maximum. The longer the rheostat wire used in the circuit, the greater the resistance is.

Text 2.

ELECTROMOTIVE FORCE AND ELECTRIC CURRENT

PRE-READING

1. Answer the following questions.

1. What do the letters “emf” stand for?
2. Is there similar abbreviation in the Russian language?

2. Practice reading the following words.

potential	[pə'tenʃ(ə)l]	naturally	['nætʧərəlɪ]
energy	['enədʒɪ]	dynamics	[daɪ'næmɪks]
gravity	['grævɪtɪ]	ampere	['æmpeə]
conductor	[kən'dʌktə]	artificial	[ˌɑːtɪ'fɪʃ(ə)l]
electromotive	[ɪˌlektrə(u)'məutɪv]	variety	[və'raɪətɪ]
alternating	['ɔːltəneɪtɪŋ]	circuit	['sɜːkɪt]
cycle	['saɪkl]		

VOCABULARY

3. **Study and remember the words.**

suspend	[sə'spend]	вешать, подвешивать
attach	[ə'tæʧ]	прикреплять
exert	[ɪg'zɜːt]	прилагать усилия
charge	[ʧɑːʤ]	заряд
potential difference	[pə'tenʃəl 'dɪfərəns]	разность потенциалов; электрическое напряжение
maintain	[meɪn'teɪn]	поддерживать, сохранять
internal	[ɪn'tɜːn(ə)l]	внутренний

rub	[rʌb]	тереть, натирать
transfer	[træns'fɜː]	переносить, перемещать
cease	[siːs]	переставать, прекращать
provide	[prə'vaɪd]	снабжать; давать
electromotive force	[ɪˌlektrəu'məutɪv 'fɔːs]	электродвижущая сила
measure	['meʒə]	измерять
power	['pauə]	питать (электро) энергией
outlet	['autlet]	штепсельная розетка
terminal	['tɜːmɪnəl]	клемма; ввод/вывод
rate	[reɪt]	рассчитывать; подсчитывать
sustain	[sə'steɪn]	поддерживать; обеспечивать;
swing	[swɪŋ]	размах, амплитуда колебания
lightning	[ˈlaɪtnɪŋ]	молния
equalize	[ˈiːkwəlaɪz]	уравнивать
circuit	['sɜːkɪt]	цепь, контур; схема
direct current (DC)	[dɪˈrekt ˈkʌrənt]	постоянный ток
alternating current (AC)	[ˈɔːltəneɪtɪŋ ˈkʌrənt]	переменный ток
imply	[ɪmˈplaɪ]	означать

READING

4. Read the text and answer the questions.

ELECTROMOTIVE FORCE AND ELECTRIC CURRENT

Picture an old-fashioned shower: a bucket of water suspended over your head, perhaps from the branch of a tree, with a rope attached that you pull to release the water in a stream. The water flows downward in this case because of the force of gravity.

The water above your head has a type of potential energy that called *gravitational* potential energy. The water got that potential energy through the work exerted in pulling the bucket up into the branch above your head.

We can think of *electrical potential energy* in the same way. Static charge is charge that does not flow; however, if charge is able to flow (because of the presence of a conductor), it will flow from higher to lower potential, in the same way that water flows downhill.

In the production of lightning, for example, an *electric current,* or flow of electrons, results when the potential difference between the cloud and the ground gets sufficiently large.

Once potential difference is equalized, because of the flow of electrons, the current will stop flowing. To keep a current flowing there must be a way to artificially (or naturally) maintain a potential difference between two points. In the case of lightning, the potential difference is maintained by the internal dynamics of certain types of clouds. Rubbing a glass rod with silk transfers electrons from the rod to the silk, which creates a potential difference between these two materials. Touching the rod to another material will cause a current of electrons to flow from the object into the glass rod (since it has a deficit of electrons). Once the rod has been discharged, though, current will cease to flow. We measure current as a flow rate, in units of charge per unit time. An *ampere* (commonly called an *amp,* and abbreviated A) is a flow rate of 1 C/s. If a current of 100 A is flowing (and this is a large current by the way!), that means that 100 C are passing a given point in a conductor every second.

The electric currents that surround us in our daily lives are maintained through artificial means and are able to provide a more steady flow of electrons, a more steady current. We say that any device that maintains a potential difference provides an *electromotive force (emf).* Electromotive force is measured in volts, just like potential difference. The batteries that power all the personal electronics that we use, and the electrical generators that provide the current available at the outlets in our homes, provide the potential difference that allows charge to flow.

There are two basic types of current, direct current (DC) and alternating current (AC). *Direct current* refers to electron flow in a single direction with time. Batteries of all varieties provide direct currents. Batteries have a positive and a negative terminal, and are rated in the voltage (potential difference) that they can sustain. Car batteries, for example, are typically 12 V DC. Batteries that power your CD player may be 1.5 V DC, and you may need two of them to provide the power that your CD player requires.

The electrons that flow in *alternating currents* do not push electrons in a single direction but, rather, move back and forth, in a motion similar to the motion of a swing (simple harmonic motion). Because the electrons are constantly changing direction, this implies that the voltage of the emf changes as well. The rate of change of the direction of the current (and voltage) in an AC circuit is measured in cycles per second (1/s) or hertz (Hz). In the United States, the current varies at a rate of 60 cycles per second, or 60 Hz, and maintains a voltage of 110 to 120 V.

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QUESTIONS:

1. What makes the water flow downward in an old-fashioned shower?
2. What type of energy does the water have in this case?
3. Why does the author describe the shower?
4. In what case will the current stop flowing?
5. What must be done to keep a current flowing?
6. Describe the experiment with a glass rod and silk. Why is it described in the text?
7. What is ampere?
8. What provides an electromotive force?
9. What is *emf* measured in?
10. What does direct current refer to?
11. What current is produced in batteries?
12. How do electrons that flow in alternating current move?
13. What is measured in cycles per second?

VOCABULARY WORK

5. **Translate the following word combinations into Russian.**

1. force of gravity	
2. static charge	
3. flow of electrons	
4. to maintain a potential difference	
5. steady flow of electrons	
6. to provide the power	
7.to push electrons in a single direction	
8. to vary at a rate	

6. **Find English equivalents to the following word combinations in the text.**

1. потенциальная энергия
2. создавать разность электрических потенциалов
3. ток перестанет течь
4. скорость потока
5. единица заряда
6. постоянный поток электронов
7. постоянный ток
8. переменный ток
9. автомобильный аккумулятор
10. двигаться возвратно-поступательно
11. движение маятника
12. гармоническое движение

***7.* Match the following words with definitions and translate them into Russian.**

1. gravitational potential energy	a. Smallest indivisible particle with negative charge.
2. charge	b. Difference in electric charge between two objects; a charge will tend to move from the area of higher potential to the area of lower potential.
3. electron	c. Energy associated with position in a gravitational field, or the amount of work an object can perform by returning to its original position.
4. gravity	d. Property of matter that is a measure of its excess or deficit of electrons.
5. potential difference	e. Attractive force between objects with mass; the curvature of space-time induced by the presence of mass.
6. ampere (amp)	f. Charge that does not flow.
7. volt	g. Rate of flow equal to one coulomb of electric charge per second.
8. static charge	h. Measure of potential difference.

8. What do the letters in the following abbreviations stand for?

AC, DC, emf, GPE.

9. Find out the key words of the text.

10. Use the key words of the text to make up the outline of the text.

11. Write out the main idea of the text. Be ready to speak about it.

12. Give the summary of the text.

COMPREHENSION

13.Read the text and find in it the answers to the questions that follow it.

TRANSFORMERS

A coil of wire wrapped around an iron core makes an electromagnet, which intensifies the field generated by the motion of the current through the coiled wire. If we place two of these electromagnets next to one another in close proximity (but not touching), we have what is called a *transformer.* One reason that alternating current is widely used to transfer electrical energy over long distances is that voltage and current values may be readily and efficiently changed by the use of these devices.

In principle, the pair of coils in Figure 1 is a transformer. Any change in the current in the primary coil induces a current in the secondary coil. If an alternating current is supplied to the primary, there will be a corresponding variation of magnetic flux through the secondary. As a result, an alternating current of the same frequency will be induced in the secondary coil. In the United States the frequency used on domestic power lines is 60 cycles per second - that is, the current makes 60 complete oscillations per second, or 60 Hz.

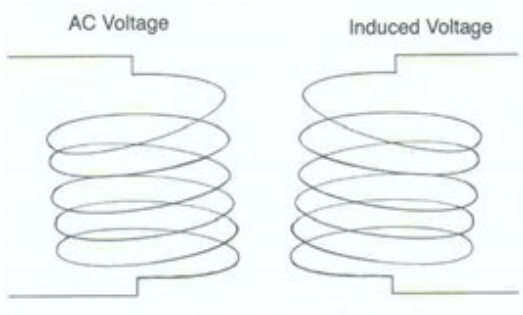

Figure 1

In iron-core transformers, the voltages in the two coils are proportional to the number of turns, or

$$14.\ V_s/V_p = n_s/n_p$$

where V_s = voltage in the secondary, V_p voltage in the primary, n_s = number of turns in secondary, and n_p = number of turns in primary. If there are more turns in the secondary

than in the primary, the voltage of the secondary will be greater than the primary voltage, and the device is called a *step-up transformer;* conversely, if there are more turns in the primary than in the secondary, the device is a *step-down transformer.*

When electric power is to be used at a great distance from the generator, it is transmitted in the form of high-voltage AC, for the following reason: the heat loss in an electric power line is proportional to I^2R, so if the losses are to be minimized, the current should be as small as possible. If the power is a constant, this restriction means that the voltage must be high, since $P = IV$.

Transformers work only with alternating currents, as described in the experiments of Faraday and Lenz. In a power plant, the generator voltage may be as high as 10,000 V. A transformer steps this voltage up to perhaps 230,000 V and places this voltage on the transmission line. At the edge of a city, a step-down transformer may reduce the potential difference to about 2300 V, and small step- down transformers located on power-line poles throughout the city then reduce it to a safe value of about 110 V for use in homes.

There are no moving parts in a transformer, and when these devices are properly designed the energy losses may be as low as 2 percent. This means that, practically, the same amount of power is developed in each coil. As in the case of direct current, the power developed in either coil is equal to current multiplied by voltage, so that $I_pV_p = I_SV_S$, or $I_s/I_p = V_p/V_s$. Combining this equation with the preceding relation, we have

$$15. I_s/I_p = n_p/ n_s$$

so that the currents in the two coils are inversely proportional to the number of turns in each.

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QUESTIONS:

1. What is a transformer used for?
2. What does a transformer consist of?

3. What is the dependence between the primary and secondary coils?
4. What type of transformer is called a step-up transformer?
5. What type of transformer is called a step-down transformer?
6. What is the relation between the number of turns in the coils and the voltages?

11. **Fill in the gaps with the following words***: circuits, parallel circuit, breaks, switch, series circuit, battery, connection, parallel.*

TYPES OF ELECTRIC CIRCUITS

There are different ways of categorizing electric … (1). One way is series versus parallel circuits. A … (2) is a circuit where the components are connected in one continuous loop. A … (3) is a circuit where the components are connected in separate branches. Most real life circuits are combinations of these two concepts, since each type has advantages. When something … (4) in a series circuit, the whole circuit stops working. This does not happen with … (5) circuits. A series circuit can therefore be useful for safety features like fuses, but not so useful for Christmas lights. Series circuits are also cheaper to produce.

COMPONENTS OF ELECTRIC CIRCUITS

There are many different components you might find in an electric circuit, including batteries, switches, bulbs, resistors, and capacitors.

A … (6) is a device that stores energy in chemical form. When it is connected to a circuit, it releases that energy to provide power to other components that are connected. A … (7) is something you can use to break a circuit at a particular point. Electrical devices will not work unless there is a complete loop between them and both sides of a power source (such as a battery). So if you cut the … (8) anywhere in the loop, the power stops. This is how light switches turn lights on and off unless there is a complete loop between them and both sides of a power source (such as a battery).

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SPEAKING

12. Make up the presentation about one of the physicists (M. Faraday, G. Ohm, A. Ampere, A. Volta, B. Franklin, …) who made the great contribution in the field of electricity.

13. Quiz "What do you know about Electric Engineering?" Ask and answer the questions with your partner. Make up dialogues.

1. What is electricity?
2. How did people discover electricity?
3. What materials did Greek scientists use in the first electrostatics experiments?
4. What does electrostatics study?
5. What are the units of measurement of electric field?
6. Where are field lines directed in electric field?
7. What is called resistance?
8. What does the resistance of a material depend on?
9. What materials are called superconductors?
10. What is an electrical circuit?
11. What provides an electromotive force?
12. What is *emf* measured in?
13. What does direct current refer to?
14. What current is produced in batteries?
15. How do electrons that flow in alternating current move?
16. What does a transformer consist of?
17. What did B. Franklin invent?
18. What is G. Ohm famous for?
19. Who was the first to get the electric current?
20. What is M. Faraday noted for?

UNIT 3. ELECTRONICS

Text 1.

DEVELOPMENT OF ELECTRONICS

PRE-READING

1. Answer the following questions.

1. Give the definition of the word ‘electronics’.

2.Can you imagine modern life without electronics***?***

2. **Practice reading the following words.**

transmission	[trænzˈmɪʃən]	consumption	[kənˈsʌmpʃən]
trajectory	[trəˈdʒektərɪ]	reliable	[rɪˈlaɪəbl]
manipulation	[məˌnɪpjuˈleɪʃən]	manufacturing	[ˌmænjuˈfæktʃərɪŋ]
technology	[tekˈnɔlədʒɪ]	conductor	[kənˈdʌktə]

3. **Read and think about the meaning of the following international words.**

Electronics; electron; physics; information; microelectronics; industrial; design; to calculate; trajectory; phenomena; nature; automatization; production; process; organism; vacuum tube; specialize; function; progress; radio; communication; technology; transistor; electrode; component; to realize; system; discrete; chip.

VOCABULARY

4. Study and remember the words.

applied physics	[əˈplaɪd ˈfɪzɪks]	прикладная физика
generation	[ˌdʒenəˈreɪʃən]	создание, формирование, выработка
manipulation	[məˌnɪpjuˈleɪʃən]	управление; обработка; преобразование
reduced weight	[rɪˈdju:st weɪt]	уменьшенный вес

power consumption	[ˈpauəkənˈsʌmpʃən]	потребление электроэнергии
to carry out	[ˈkærɪ aut]	выполнять
to respond	[rɪsˈpɔnd]	отвечать; реагировать
integrated circuit (IC)	[ˈɪntɪgreɪtɪdˈsə:kɪt]	интегральная схема
batch processing	[bætʃˈ prəusesɪŋ]	пакетная обработка
to assemble	[əˈsembl]	собирать; монтировать
to lower manufacturing	['ləuəˌmænjuˈfæktʃərɪŋ]	снизить производительность

READING

5. Read the text and answer the questions.

DEVELOPMENT OF ELECTRONICS

Electronics is a field of engineering and applied physics dealing with the design and application of electronic circuits. The operation of circuits depends on the flow of electrons for generation, transmission, reception and storage of information.

Today it is difficult to imagine our life without electronics. It surrounds us everywhere. Electronic devices are widely used in scientific research and industrial designing, they control the work of plants and power stations, calculate the trajectories of spaceships and help the people discover new phenomena of nature. Automatization of production processes and studies on living organisms became possible due to electronics.

The invention of vacuum tubes at the beginning of the 20th century was the starting point of the rapid growth of modern electronics. Vacuum tubes assisted in manipulation of signals. The development of a large variety of tubes designed for specialized functions made possible the progress in radio communication technology before the World War II and in the creation of early computers during and shortly after the war.

The transistor invented by American scientists W. Shockley, J. Bardeen and W. Brattain in 1948 completely replaced the vacuum tube. The transistor, a small piece of a semiconductor with three electrodes, had great advantages over the best vacuum tubes. It provided the same functions as the vacuum tube but at reduced weight, cost, power consumption, and with high reliability. With the invention of the transistor all essential circuit functions could be carried out inside solid bodies. The aim of creating electronic circuits with entirely solid-state components had finally been realized. Early transistors could respond at a rate of a few million times a second. This was fast enough to serve in radio circuits, but far below the speed needed for high-speed computers or for microwave communication systems.

The progress in semiconductor technology led to the development of the integrated circuit (IC), which was discovered due to the efforts of John Kilby in 1958. There appeared a new field of science — integrated electronics. The essence of it is batch processing. Instead of making, testing and assembling discrete components on a chip one at a time, large groupings of these components together with their interconnections were made all at a time. IC greatly reduced the size of devices, lowered manufacturing costs and at the same time they provided high speed and increased reliability.

Adopted from Радовель, В. А. Английский язык для технических вузов : учебное пособие / В.А. Радовель. - 2-е изд. - Москва : РИОР : ИНФРА-М, 2022. - 296 с.

QUESTIONS:

1. Where are electronic devices used?
2. What was the beginning of electronics development?
3. What made the progress in radio communication technology possible?
4. What is the transistor?
5. When was the transistor invented?
6. What aim was realized with the invention of the transistor?
7. When were integrated circuits discovered?
8. What advantages did the transistors have over the vacuum tubes?

VOCABULARY WORK

6. Match the words similar in meaning.

1. invent	a. answer
2. operation	b. part
3. imagine	c. discover
4. component	d. pretend
5. respond	e. work
6. trajectory	f. keeping
7. storage	g. path

7. Match the words opposite in meaning.

1. development	a. reject
2. solid-state	b. ancient
3. realize	c. decline
4. rapid	d. liquid
5. modern	e. slow
6. early	f. connected
7. increase	g. late
8. discrete	h. lower

8. Find English equivalents to the following word combinations in the text.

1. применение электронных схем
2. передача и прием информации
3. вычислять траекторию космических кораблей
4. способствовать управлению сигналами
5. полупроводниковый кристалл
6. потребление электроэнергии
7. высокая надежность
8. твердотельные компоненты
9. высокоскоростной компьютер

10. микроволновые системы связи

11. полупроводниковая технология

12. сборка дискретных компонентов на кристалле

9. Match English and Russian equivalents.

1. scientific research	a. со скоростью
2. due to the efforts	b. твердое тело; кристалл
3. to replace vacuum tubes	c. полупроводниковый кристалл
4. a piece of semiconductor	d. увеличить надежность
5. solid body	e. благодаря усилиям
6. at a rate	f. научные исследования
7. to increase reliability	g. заменять электронные лампы

10. Insert the necessary word in the gap.

1. Electronics is a science studying the use of …:

a) computers; b) electronic circuits;

c) radio signals; d) reception of information.

2. Transistors have many … over vacuum tubes.

a) patterns; b) advantages;

c) scales; d) forms.

3. They … very little power.

a) consume; b) generate;

c) embrace; d) convert.

4. The transistor consists of a small piece of a … with three electrodes.

a) diode; b) anode;

c) conductor; d) semiconductor.

5. … contributed greatly to the discovery of integrated circuits.

a) W. Shockley; b) J. Kilby;

c) W. Brattain; d) J. Bardeen.

11. Give the title to each paragraph of the text.

12. Retell the text using the titles.

COMPREHENSION

13. What do you know about the phenomenon and possible practical uses of superconductivity? Read the text and answer the questions.

1. What is superconductivity?
2. What temperature is called “absolute zero”?
3. How many years ago was superconductivity discovered?
4. What conditions enable some metals to become superconductive?
5. Why hasn’t superconductivity become widely used in practice?
6. Why is liquid nitrogen more attractive as a coolant than liquid helium?
7. What fields of superconductor application could you name?

SUPERCODUCTORS

Superconductivity is aptly named. It involves a remarkable transition that occurs in many metals when they are cooled to temperatures within several degrees of absolute zero, or, 0 Kelvin. Absolute zero equivalent to -460°F or -273°C represents a total absence of heat; it is the coldest temperature conceivable. As the metals approach this frigid limit, they suddenly lose all their electrical resistance and become superconductors. This enables them to carry currents without the loss of any energy and in some cases to generate immensely powerful magnetic fields. Scientists have recognized that the implications of this phenomenon could be enormous, but reaching and maintaining the temperatures necessary for superconductivity in these metals is difficult and expensive.

From the time that a Dutch physicist Kamerlingh Onnes discovered superconductivity in 1911 until the recent rush of breakthroughs, there was only one way to produce the phenomenon: by bathing the appropriate metals — and later, certain metallic alloys – in liquid helium.

This exotic substance is produced by lowering the temperature of rare and costly helium gas to 4.2K (-452°F), at which point it liquefies. But the process is expensive and requires considerable energy. Furthermore, unless the liquid helium is tightly sealed

in a heavily insulated container it quickly warms and vaporizes away. Thus, the practical use of superconductors has been limited to a few devices — an experimental Japanese magnetically levitated train, a few giant particle accelerators and medicine's magnetic resonance imaging machines that operate with intense magnetic fields.

But in the last few years physicists have stumbled on unusual cases of ceramic compounds that change everything. They also must be cooled to become superconductors but only to a temperature of 98 K (-283°F) and that suddenly brings superconductivity into the range of the practical: liquid helium can be replaced as a coolant by liquid nitrogen, which makes the transition from a gas at the easily produced temperature of 77 K (-320°F). Moreover, liquid nitrogen is cheaper than milk and so long-lasting that scientists carry it around in ordinary thermos bottles. Also, the ceramics may be able to generate even more intense magnetic fields than metallic superconductors.Thus, if these new substances can be turned into practical devices technology will be transformed.

Adopted from Курашвили Е.И., Кондратьева И.И., Штрунова В.С.. Английский язык для студентов-физиков.: учеб. пособие— М.: Астрель: АСТ, 2005. – 189 с.

14. Read the passage. Give the title to the text and translate it in writing.

We can use a combination of n- and p-type crystals to carry out the functions of a triode tube. Such an arrangement is known as a transistor. It consists of a p-type crystal placed between two n-type crystals. If we apply to the middle and to the right crystal an electric voltage from a battery no current will flow through the system. Things will change, however, if a small electric voltage from the battery is applied to the central and to the left crystal. In this case current will start to flow through the n-p-junction on the left. However, many electrons entering into the p-type crystal will continue across it and enter the n-type crystal on the right, thus permitting a current from the battery to flow through the right n-p-junction. The situation is quite similar to that existing in a triode tube, and the crystal on the left plays the role of the filament, while the middle crystal and the crystal on the right play the role of grid and plate. The principal advantage of transistors over vacuum tubes lies in the fact that the controlled

flow of electrons takes place entirely within solid material. Thus it is not necessary to use a large amount of power to keep a filament red-hot to eject electrons into space. This, in addition to their simplicity, reliability and small size, have taken rapidly causing transistors to take the place of the old-fashioned vacuum tubes in many fields of electronics.

n-p junction – n-p переход *grid - решетка, сетка*

filament – нить накала

Adopted from Курашвили Е.И., Кондратьева И.И., Штрунова В.С.. Английский язык для студентов-физиков.: учеб. пособие— М.: Астрель: АСТ, 2005. – 189 с.

15. Translate the text into Russian. Find some more information about the phenomenon of superconductivity and modern researches in this field?

In 1987, each new report of achieving superconductivity at a higher temperature was received with excitement by the physics community. By summer, claimed records were approaching room temperatures, but enthusiasm was cooling. In December, signs of superconductivity above the boiling point of water (373 K) were reported. However, most observers were skeptical, reflecting growing doubts that the existence of superconductivity above 100 K has been proved.

During the second half of the year, about 20 research groups reported evidence for superconductivity above 100 K. However, at the Boston meeting, Paul Chu, the researcher from the University of Houston, who made the first superconductor at 90 K, said higher-temperature observations were "unstable superconducting anomalies. He stressed that reports of high-temperature superconductivity should meet four criteria: zero resistance; demonstration of the Meissner effect (the exclusion of magnetic fields from a superconductor); stability; and reproducibility. Although he said that there was "no clear evidence to exclude" the possibility of superconductivity well above 100 K.

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Text 2.

SEMICONDUCTORS

PRE-READING

1. Answer the following questions.

1. Why is the development of electronics called a revolution?
2. What do you know about semiconductor technology***?***

2. Practice reading the following words.

semiconductor	[ˌsemɪkən'dʌktə]	crystal	[ˈkrɪstəl]
thermal	['θɜːməl]	crystalline	['krɪstəlaɪn]
impurity	[ɪmˈpjʊərɪti]	lattice	[ˈlætɪs]
occur	[əˈkɜː]	spotless	[ˈspɒtləs]
acceptor	[əkˈseptə]	regularity	[ˌregjʊˈlərɪtɪ]
carrier	['kærɪə]	agitation	[ˌædʒɪ'teɪʃən]
chemical	['kemɪkəl]		

VOCABULARY

3. Study and remember the words.

spotless regularity	[ˈspɒtləs ˌregjʊˈlərɪtɪ]	безупречная правильность
give rise	[gɪv raɪz]	вызывать
crystal lattice	[ˈkrɪstəlˈlætɪs]	кристаллическая решётка
semiconductor	[ˌsemɪkən'dʌktə]	полупроводник
acceptor	[əkˈseptər]	акцептор (дырка)
silicon crystal	[ˈsɪlɪkən ˈkrɪstəl]	кристалл кремния
valence	[ˈveɪləns]	валентность

conductive	[kənˈdʌktɪv]	проводящий
arsenic	[ˈɑːsənɪk]	мышьяк
free electron	['friː ɪˈlektrɒn]	свободный электрон
electric carrier	[ɪˈlektrɪk ˈkærɪə]	электрический носитель
electron bond	[ɪˈlektrɒn ˈbɔnd]	электронная связь
boron	[ˈbɔːrɔn]	бор

READING

4. Read the text and answer the questions.

SEMICONDUCTORS

Some materials cannot be classified as either insulators or good conductors as thermal agitation of the atoms can knock loose only a few electrons and permit the material be slightly conductive. Such materials are known as semiconductors. A small amount of the proper kind of impurity in the crystalline structure of a semiconductor may, however, make it enormously more conductive. A pure silicon crystal in which each atom of silicon has a chemical valence 4, is connected with four of its neighbors by four electron bonds. This situation arises when one atom of silicon is replaced by an atom of arsenic (As) which has a valence of 5. The impurities in the crystalline structure of a semiconductor make the semiconductor very conductive.

The four valence electrons of the As atom form connections (bonds) with the four neighboring Si atoms, while the fifth "black sheep" electron is left unemployed and free to travel from place to place. The impurity atoms that give rise to free electrons in this way are known as donors. A reverse situation occurs when the Si atom is replaced by a trivalent atom of boron (B). In this case there will be a vacant place, or an electron hole, that breaks up the spotless regularity of the silicon crystal lattice. The impurity atoms that give rise to such "holes" are known as acceptors. A hole formed near a foreign atom present in the lattice may be filled up by an electron originally belonging to one of the neighboring silicon atoms, but in filling this hole the electron will leave a hole at the

place where it was originally located. If this hole is filled by another neighboring electron, a new hole will move one step farther out.

Semiconductors that contain donor atoms and free electrons are known as n-type semiconductors, while those with acceptor atoms and holes are called p-type semiconductors (n and p stand for a negative and positive charge of electric carriers). The electrical conductivity of n-type semiconductors is determined by the number of free electrons per unit valence and the ease with which they move through the crystal lattice, while in the case of p-type semiconductors it depends *on* the number and mobility of the holes.

Adopted from Курашвили Е.И., Кондратьева И.И., Штрунова В.С.. Английский язык для студентов-физиков.: учеб. пособие— М.: Астрель: АСТ, 2005. – 189 с.

QUESTIONS:

1. What materials can be classified as semiconductors?
2. Under what conditions can a semiconductor become more conductive'?
3. What impurity atoms are known as donors (acceptors)?
4. What is the difference between n-type and p-type semiconductors?
5. What is their conductivity determined by?

VOCABULARY WORK

5. **Match the words similar in meaning.**

1. acceptors	a. flint
2. give rise	b. poison
3. silicon	c. engender
4. arsenic	d. additive
5. impurity	e. holes
6. occur	f. range
7. classify	g. perfect
8. spotless	h. take place

6. Match the words opposite in meaning.

1. n-type	a. insulative
2. conductive	b. doped
3. pure	c. disappear
4. occur	d. pacification
5. agitation	e. p-type
6. give rise	f. far
7. regularity	g. stop
8. neighboring	h. mess

7. Translate the following word combinations into Russian.

1. thermal agitation
2. crystalline structure
3. pure silicon crystal
4. chemical valence
5. impurity atoms
6. free electrons
7. electron hole
8. depend on
9. be replaced by an atom of
10. be filled up by an electron

8. Find English equivalents to the following word combinations in the text:

1. безупречная правильность
2. кристаллическая решётка
3. кристалл кремния
4. свободные электроны
5. электрические носители
6. тепловое возбуждение

7. электронно-дырочная

8. химическая валентность

9. чистый кристалл кремния

10. примесные атомы

9. Match the following terms with definitions and translate them.

1. semiconductor	a. a quantum transition of an atom or molecule from a lower energy level to a higher.
2. thermal agitation	b. the material, which occupies an intermediate position between conductors and insulators.
3. acceptors	c. auxiliary geometric image introduced for the analysis of the structure of the crystal.
4. valence	d. in solid state physics an impurity in the crystal lattice, which gives the crystal a p-type conductivity type, in which the charge carriers are holes.
5. crystal lattice	e. the ability of atoms of chemical elements to form a certain number of chemical bonds with atoms of other elements.

10.Match English and Russian equivalents.

1. slight conductivity	a. обратная ситуация
2. chemical valence	b. небольшая проводимость
3. electron bonds	c. черная овца
4. black sheep	d. химическая валентность
5. reverse situation	e. электронные связи

11. Insert the necessary word in the gap.

1. Semiconductors have ... conductivity.

a) electron substituted c) electron hole

b) full d) incomplete

2. ... increases conductivity of the semiconductor.

a) Arsenic c) Thermal agitation

b) Impurity d) Chemical valence

3. An atom of silicon has a chemical valency...

a) 2 c) 7

b) 5 d) 4

4. Impurity atoms that generate "holes" are called...

a) holes c) impurities

b) acceptors d) valency

5. Semiconductors that contain ... and free electrons are known as n-type semiconductors.

a) donor atoms c) impurities

b) electron hole d) electron bonds

12. Give the title to each paragraph of the text,

13. Retell the text using the titles.

COMPREHENSION

14. Make up the rendering of the following text.

Semiconductors have had a monumental impact on our society. You find semiconductors at the heart of microprocessor chips as well as transistors. Anything that is computerized or uses waves depends on semiconductors.

Today, most semiconductor chips and transistors are created with silicon. You may have heard expressions like "Silicon Valley" and the "silicon economy," and that is why – silicon is the heart of any electronic device.

Silicon is a very common element – for example, it is the main element in sand and quartz. If you look "silicon" up in the periodic table, you will find that it sits next to aluminum, below carbon and above germanium.

Carbon, silicon and germanium (germanium, like silicon, is also a semiconductor) have a unique property in their electron structure – each has four electrons in its outer orbital. This allows them to form nice crystals. The four electrons form perfect covalent bonds with four neighboring atoms, creating a lattice. In carbon, we know the crystalline form as diamond. In silicon, the crystalline form is a silvery, metallic-looking substance.

In a silicon lattice, all silicon atoms bond perfectly to four neighbors, leaving no free electrons to conduct electric current. This makes a silicon crystal an insulator rather than a conductor.

Metals tend to be good conductors of electricity because they usually have "free electrons" that can move easily between atoms, and electricity involves the flow of electrons. While silicon crystals look metallic, they are not, in fact, metals. All of the outer electrons in a silicon crystal are involved in perfect covalent bonds, so they cannot move around. A pure silicon crystal is nearly an insulator – very little electricity will flow through it. But you can change all this through a process called doping.

Downloaded from Electronics. URL: http://electronics.howstuffworks.com

15. Translate the following text into English.

Полупроводник — это особый материал

Самый популярный пример такого материала — кремний, а также химические элементы германий, селен, теллур, мышьяк и другие. В определенных условиях они могут проводить больше электричества, чем изоляторы (например, стекло, резина), но меньше, чем чистые проводники (медь или алюминий). Свойства полупроводников, в том числе кремния, можно усилить путем легирования — добавления различных примесей в исходный материал.
Процесс их изготовления и подготовки для дальнейшей работы сложный, включает много этапов. Кристаллы сверхчистого монокристаллического кремния выращиваются по методу Чохральского из расплавленного поликристаллического кремния (который, в свою очередь, получают из мелкого белого песка или кварцевого песка, очищенного от 99,999999999% других элементов). Уже после этого кристалл режется на тонкие пластины.
Полупроводники обычно используются при создании электроники, если конкретнее — микросхем в ней. Поэтому иногда их называют просто чипами (хотя это обобщение и упрощение). Их основная задача, с учетом их свойств, — контролировать как, когда и куда будет двигаться поток электронов. Они могут усиливать сигнал, переключать его и преобразовывать.

SPEAKING

16. Develop the following statement using the phrases – *in my opinion, in fact, for instance, moreover, one advantage is …, another point is that …, finally, in conclusion:*

"Electronics has extended man's intellectual power ".

17. Quiz “What do you know about Electronics?” Ask and answer the questions with your partner. Make up dialogues.

1. What is electronics?
2. What invention contributed to the development of electronics?
3. What made the progress in radio communication technology possible?
4. Who invented transistor?
5. What temperature is called “absolute zero”?
6. What fields of superconductor application could you name?
7. What materials can be classified as semiconductors?
8. Under what conditions can a semiconductor become more conductive'?
9. What are the main advantages of transistors over vacuum tubes?
10. What are the advantages of integrated circuits?

UNIT 4. INFORMATION-COMMUNICATION TECHNOLOGIES

Text 1.

THE HISTORY OF COMMUNICATION SYSTEMS DEVELOPMENT

PRE-READING

1. **Answer the following questions.**

1. What means of communication did ancient people use?
2. What are the names of scientists who made a great contribution to the development of communication systems?

2. **Practice reading the following words.**

alphabet	[ˈælfəbɪt]	microphone	[ˈmaɪkrəfəʊn]
code	[kəʊd]	modulation	[mɔdjʊˈleɪʃn]
conductor	[kənˈdʌktə]	papyrus	[pəˈpaɪərəs]
communication	[kəmjuːnɪˈkeɪʃn]	radar	[ˈreɪdə]

VOCABULARY

3. **Study and remember the words**

to transmit	[trænzˈmɪt]	передавать
wireless	[ˈwaɪəlɪs]	беспроводной
feasibility	[fiːzəˈbɪlɪtɪ]	целесообразность
intelligible	[ɪnˈtelɪʤəbl]	вразумительный
coil	[kɔɪl]	катушка
receiver	[rɪˈsiːvə]	приёмник
maritime	[ˈmærɪtaɪm]	морской

broadcasting	[ˈbrɔːdkɑːstɪŋ]	вещание, трансляция

READING

4. Read the text and answer the questions.

THE HISTORY OF COMMUNICATION SYSTEMS DEVELOPMENT

A long time ago men found it necessary to communicate at a distance. When the alphabet was invented, they began to use papyrus, and something like the modern letter appeared. The first to send letters were the ancient Egyptians. A runner delivered them. But the best postal system of ancient times was organized by the Romans.

From then on until the eighteenth century there were practically no advances in the means of communication. Even when Queen Victoria began to rule England in 1837, her means of communication with distant parts of her empire were no faster than those of Julius Caesar.

The first practical electromagnetic telegraph was invented by the Russian scientist Pavel Shilling in 1828, an in 1832 he established telegraph communication of this type between the Winter Palace and the Ministry of Transport in St. Petersburg. Shilling's work was continued in Russia by B. Yakobi, who made several improvements in the electromagnetic telegraph and linked St. Petersburg with Tsarskoye Selo. This 25 kilometer-line was the longest in the world at that time. Yakobi invented the telegraph sending key, adopted by the American Samuel Morse. Morse, however, invented the telegraph code of dots and dashes, which is used all over the world to this day.

The first transatlantic telegraph cable from Europe to America was laid in 1858 due to the great British scientist Professor William Thomson. He also invented the mirror galvanometer, the very sensitive instrument used at first to receive signals transmitted over very long cables. Three letters could be transmitted per minute over the first transatlantic cable. The present speed of operation of telegraph cables reaches 2,500 letters per minute.

The telephone is a much younger invention than the telegraph. The French mechanic Charles Boursel first suggested the idea of transmitting speech electrically. The first telephone that found application was invented by the American Graham Bell in 1876. Russian inventors made several important improvements in the telephone. In 1879 the Russian engineer Mikhalsky made a microphone with powdered carbon, a prototype of the present-day microphone. Next year another Russian inventor, Golubitsky made a far sensitive receiver than the receiver of Bell. In 1880 a Russian military communications expert G. Ignatyev invented a device that made it possible to use the same wire simultaneously for a telephone conversation and for telegraph communication. Today the method of frequency modulation makes it possible to transmit several hundred telephone conversations over the same wire simultaneously.

The telegraph and the telephone were both hailed as the "final" solution to the communications problem. But they were soon followed by an even more wonderful invention, which made possible communication without wires. Numerous scientists from different countries contributed to the appearance of wireless communication. Heinrich Hertz, constructed a primitive radio system capable of transmitting and receiving space waves through free space. In 1893, Nikola Tesla, in America, first demonstrated the feasibility of wireless communications. He proved that intelligible messages could be transmitted without wires and established a system which was composed of a transmitting coil (or conductor) and a receiving coil. At last, in 1895, the Russian scientist A.S. Popov demonstrated his first radio receiver. In March 1897 G. Marconi, an Italian inventor, transmitted wireless telegraphy signals over a distance of two miles and later he established the first transatlantic radio communication between Canada and England. For this achievement, he was awarded the Nobel Prize.

Early uses of communication were maritime for sending telegraphic messages using Morse code between ships and land. Radio was used to pass on orders and communications between armies and navies in World War I. Broadcasting became possible in the 1920s with the introduction of radio receivers in Europe and the USA. Another use of radio was the development of detecting and locating aircraft and ships

by the use of radar.

Today radio takes many forms, including wireless networks and mobile communications of all types, as well as radio broadcasting.

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QUESTIONS:

1. What were the first letters like?
2. Who delivered them?
3. What was the length of the first distant telegraph?
4. What is Samuel Morse famous for?
5. How old is the telephone communication?
6. How does the method of frequency modulation facilitate the telephone communication?
7. Who were the founders of wireless communication?
8. What are the forms of radio communication nowadays?

VOCABULARY WORK

5. Match the words similar in meaning.

1. Distant	a) connect
2. Establish	b) far
3. Link	c) at the same time
4. Application	d) found
5. Simultaneously	e) use

6. Match the words opposite in meaning.

1. Ancient	a) complicated
2. Sensitive	b) destroy
3. Construct	c) modern

4. Primitive	d) rare
5. Numerous	e) rough

7. Translate the following word combinations into Russian.

1. Communication system;
2. Practical electromagnetic telegraph;
3. The Ministry of Transport;
4. Transatlantic telegraph cable;
5. Theoretical basis;
6. A primitive radio system;
7. Radio signals;
8. Transatlantic radio communication;
9. The Nobel Prize;
10. Morse code.

8. Find English equivalents in the text.

1. Нечто подобное;
2. Средства связи;
3. Телеграфный ключ;
4. Точки и тире;
5. Зеркальный гальванометр;
6. Порошковый углерод;
7. Гораздо более чувствительный приёмник;
8. Метод частотной модуляции;
9. Беспроводная связь;
10. Передающая / принимающая катушка.

9. Mark the following sentences True or False.

1. Romans were the first to organize the delivering of letters.
2. Queen Victoria was ruling England in the 18th century.

3. The first electromagnetic telegraph appeared in Russia.
4. There are two symbols in Morse code.
5. Nowadays people can transmit 2 500 words per minute using telegraph cables.
6. The first wireless communication was realized between the USA and England.

10.Complete the gaps with the correct word.

1. It is known that W. Thomson invented the …. .

a) induction coil; b) tuning circuit; c) sending key; d) mirror galvanometer.

2. The method of … modulation gives the possibility to transmit a lot of telephone conversations over the same wire simultaneously.

a) accuracy; b) currency; c) frequency; d) reliability.

3. The first postal system with papyrus letters was organized by the ….

a) Romans; b) British; c) Egyptians; d) Russian.

4. It was … who invented transmitting and receiving coils and described the possibility of wireless communication.

a) G. Marconi; b) A. Popov; c) H. Hertz; d) N. Tesla.

5. The aim of any form of … is to provide complete understanding of a message.

a) communication; b) computation; c) calculation; d) completion.

11. Match the following terms with their definitions.

1. Modulation	a) the number of vibrations per second.
2. Frequency	b) anything gathered into a series of rings or a spiral.
3. A coil	c) a device that converts incoming electric signals into audible or visual signals.
4. A switch	d) a device that generates radio waves, modulate their amplitude or frequency and transmit them by means of antenna.

5. A receiver	e) a device used to open or close an electric circuit.
6. A transmitter	f) a variation in the amplitude, frequency or phase of a wave in accordance with some signal.

12. Divide the text "The history of communication systems development" into logical parts and give subtitles to each part.

13. Retell the text using the titles.

COMPREHENSION

14. **Read the text about Alexander Popov and answer the questions.**

1. What happened on May 7, 1895?
2. What was the name of the first apparatus for radio communication?
3. What does the word "radio" mean in Latin?
4. When did Popov die?
5. How is the Popov's invention used nowadays?

ALEXANDER POPOV

(1859-1906)

Alexander Popov is one of the greatest Russian scientists. He was born in 1859 in a small town. He liked to learn very much. In 1882 he graduated from the university in St. Petersburg. First he worked as a physics teacher, then he was the director of the Electrotechnical Institute. A. Popov was the honourable member of the Russian Technical Society.

Radio was invented in Russia according to the Popov's work. It was he who built the world's first receiver in 1895. There were no transmitters then. That's why his receiver could only pick up signals produced by lightning discharges during a thunderstorm. A. Popov demonstrated a device called a storm-indicator at a meeting of scientists in St. Petersburg on May 7, 1895. This day is marked now as a Radio day.

Soon A. Popov found a way of transmitting Morse code signals. In 1896 he sent the world's first wireless telegram over a distance of 250 meters, and four years later the range of transmission was increased to 50 kilometers. Since then, the method of transmission and reception has been constantly improved. Nowadays radio communication has no limits.

The very first apparatus for radio communication was called wireless telegraph or wireless telephone. Later a shorter word radio (from Latin "radius" – the ray) was taken. The word is used because electromagnetic or radio waves travel from a radio station along radii, just as rays of light at the speed of 300000 km/sec. Radio is a special kind of long-distance electrical communications. It makes possible to send different signals such as dots and dashes of the Morse code (radio-telegraphy), speech and music (radio telephony), images of objects and films (television). Radio helps us to maintain contact with ships, with spacecraft, etc.

Daily radio programs include lectures, reports, and concerts. Radio is a powerful means of spreading knowledge.

Pick up – принимать, storm-indicator - "грозоотметчик",

radii = radius – радиус.

15. Read the text and answer the questions. Give the main points of the text in 4-5 sentences.

RADIO COMMUNICATION

1. What is radio communication?
2. What are the main components of radio?
3. What is the difference between radio waves and other waveforms?

Radio communication is the transfer of high-frequency energy from the transmitter to the receiver without wires.

Radio is a device that transmits and receives signals and programs by electromagnetic waves. Since the process of radio communication includes transmission and reception of signals, the necessary components of radio are a transmitter and a receiver.

The transmitter is a device that produces radio-frequency energy. The main parts of a transmitter are a high-frequency oscillator including an oscillatory circuit and one or more amplifiers. In modern transmission electron tubes are used to amplify currents and give greater transmitting range and better reception.

The receiver is a device that receives waves sent out by a transmitter. Radio receiver demodulates the waves and they are heard as speech, music and signals.

Electric oscillations are produced in the antenna of the transmitter. They travel in all directions.

Radio waves are electric waves of very high frequency; they travel through space at the speed of light. They differ from other waveforms only in frequency (number of vibrations per second).

Downloaded from: Radiocommunication. URL:: https://studfile.net/preview/3682101/page:15/

16.Write the translation of the text.

THE MAGNITUDE OF INVENTION

The electric telegraph was the beginning of the whole vast tele-communications industry, the forerunner of the telephone, radio, television, communications satellites – in fact, a direct ancestor of everything now united under the convenient heading of "electronics".

As early as 1747 electrical impulses had been transmitted along a wire laid across Westminster Bridge, and detected at the other end by the crude

but effective method of having someone hold on to the wire. Strangely enough, the man who put most effort into developing the telegraph was a successful American painter and sculptor, Samuel Morse. On April 1, 1845, the world's first telegraph line between Baltimore and Washington has been opened for public use, and after that the telegraph spread rapidly across Europe and America.

Joining the continents proved a much more difficult job, but in 1856 the Atlantic Telegraph Company was organized to attempt the most demanding technical feat of the age and, in 1859, the Atlantic cable was completed. Wheatstone had coined the word telephone in 1821, when he was only 19. Many others contributed ideas, but it was the energy and persistence of Alexander Graham Bell which made the telephone a practical instrument. Bell first realized how a telephone could be made to work in June 1875. After that progress was very rapid. The first permanent telephone line was opened in April 1876 in Boston.

Had coined the word – создал (придумал) слово, forerunner – предвестник, ancestor – предок, crude – грубый.

17. Write the translation of the text "The investigation of scientists in the field of radio electronics".

THE INVESTIGATION OF SCIENTISTS IN THE FIELD OF RADIOELECTRONICS

The path to Popov's great discovery was marked by the investigations of many scientists in different countries. Popov's scientific accomplishment was the culmination of the efforts of several generations of scientists, whose works make up the early history of radio which began with the investigations of Faraday.

Faraday's discovery of electromagnetic rotation and electromagnetic induction laid the foundation of present-day electrical engineering. His natural-scientific conceptions

created a revolution in the understanding of electrical phenomena, and are extremely important because they directed all attention to the medium surrounding the electrified body. Faraday's theory of magnetic and electric lines of force proved to be exceedingly fruitful and served as a starting point for J.C. Maxwell to deduce mathematically (and Hertz to detect experimentally) - the existence of free electric waves. Later it was found that as early as 1832 Faraday himself was close to what triumphed in science more than half a century later.

Faraday's scientific views were developed by his successor Maxwell, who worked in many fields of physics, mechanics, and even astronomy. However, his chief works are investigations in electromagnetism and in the kinetic theory of gases. Continuing Faraday's work, Maxwell subjected his ideas to mathematical treatment and arrived at far-reaching conclusions when he advanced the electromagnetic theory of light, one of the greatest achievements of science of the 19th century. Maxwell considered light to be an electromagnetic phenomenon; he predicted mathematically that electric waves ought to propagate at a velocity equal to the ratio of electromagnetic and electrostatic units, as we know, this value coincide with the velocity of light (approximately 300.000 km per second).

Propagate – распространяться, medium - среда,

successor – последователь, coincide – совпадать.

SPEAKING

18. **Make the presentation about one of the scientists who made a great contribution to the development of communication systems (P. Shilling, S. Morse, H. Hertz, A. Popov, G. Marconi, N. Tesla,…)**

Text 2.

COMMUNICATION SYSTEMS AND INFORMATION THEORY

PRE-READING

1.Answer the following questions.

1. What communication systems do you know?

2. What does the abbreviation ICT stand for?

2.Practice reading the following words.

radar	[ˈreɪdɑː]	process	[ˈprəʊsəs]
technology	[tek'nɔlədʒɪ]	special	['speʃ(ə)l]
channel	[ʧænl]	function	['fʌŋkʃ(ə)n]
emphasis	[ˈemfəsɪs]	satellite	[ˈsæt(ɪ)laɪt]

VOCABULARY

3. Study and remember the words

source output	[sɔːs ˈaʊtpʊt]	исходный вывод
sequence	[ˈsiːkwəns]	последовательность
distinguishing	[dɪsˈtɪŋgwɪʃɪŋ]	отличительные
performance	[pəˈfɔːməns]	пропускная способность
prescribed	[prɪˈskraɪbd]	заданная
installing	[ɪnˈstɔːlɪŋ]	установка
application	[æplɪˈkeɪʃn]	прикладная программа
networking	[ˈnetwɜːkɪŋ]	объединение в сеть
disseminate	[dɪˈsemɪneɪt]	распространять
stem (from)	[stem]	происходить
manipulate	[məˈnɪpjʊleɪt]	Управлять, обрабатывать

READING

4. **Read the text and answer the questions.**

COMMUNICATION SYSTEMS AND INFORMATION THEORY

Communication theory deals primarily with systems for transmitting information from one point to another. The source output might represent a voice waveform, a sequence of binary digits from a magnetic tape, he output of a set of sensors in a space probe, or a target in a radar system. The channel might represent a telephone line, a high frequency radio link, a space communication link, or a storage medium.

As it is known, in the early 1940's a mathematical theory for dealing more fundamental aspects of communication systems was developed. The distinguishing characteristics of this theory are, first, a great emphasis on the theory of probability and, second, a primary concern with the encoder and decoder, both in terms of their functional roles and in terms of their achieving a given level of performance. In the past 20 years, information theory has been made more precise, has been extended and brought to the point where it is being applied in practical communication systems.

Much of modern communication theory stems from works of communication systems as well as from desirability of modelling both signal and noise as random processes. N. Wiener was interested in finding the best linear filter to separate the signal from additive noise with a prescribed delay. His work had an important influence on subsequent research in modulation theory.

Information technology (IT) is the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware. Information technology deals mainly with the use of electronic computers and computer software to convert, store, protect, process, transmit and securely retrieve information.

Today the term information technology includes many aspects of computing and technology and covers many fields. Information technology professionals perform a variety of duties that range from installing applications to designing complex computer networks and information databases. The duties of IT specialists may involve data management, networking, engineering computer hardware, database and software design, as well as the management and administration of the whole system. When computer and communication technologies are combined, the result is information technology, or "infotech". Information technology describes any technology that helps to produce, manipulate, store, communicate and/or disseminate information.

Thus, Information Communication Technology (ICT) embraces all technologies for the communication of information. It includes any medium to record information (paper, pen, magnetic disc / tape, optical discs – CD / DVD, flash memory, etc.) and technology for broadcasting information – radio, television. It involves any technology for communicating through voice and sound or images – microphone, camera, loudspeaker, and telephone. At present it is apparently culminating to information communication with the help of Personal Computers (PCs) networked through the Internet, information technology that can transfer information using satellite system or intercontinental cables.

QUESTIONS:

1. What system does communication theory deal with?
2. When was the mathematical theory for communication systems developed?
3. What are the distinguishing features of the theory?
4. What does modern communication theory stem from?
5. What was Wienner's contribution into the development of communication theory?
6. What does IT deal with?

7. What jobs are IT experts engaged in?

8. What do you understand by “infotech”?

9. What technologies does ICT include?

VOCABULARY WORK

5. Translate the following word combinations into Russian.

1. A voice wave form;
2. a high frequency radio link;
3. a great emphasis on the theory of probability;
4. to have influence on subsequent research;
5. a prescribed delay;
6. to retrieve information securely;
7. perform a variety of duties;
8. to design complex computer networks;
9. to communicate through voice and sound or images;
10. to network through the Internet.

6. Find English equivalents to the following word combinations in the text.

1. Технология организации дальней связи;
2. беспроводная связь;
3. апередача в режиме реального времени;
4. сигнал от аддитивных шумов;
5. высокочастотная радиосвязь;
6. беспорядочные процессы;
7. автоматизированные информационные системы;
8. последовательность двоичных цифр;
9. размещать прикладные программы;
10. уровень пропускной способности

7. **Match the words similar in meaning.**

1. Publish	a) machine
2. Device	b) important
3. Progress	c) take place
4. Significant	d) distant
5. Remote	e) issue
6. Occur	f) develop

8. **Match the words opposite in meaning.**

1. Forward	a) slowly
2. Rapidly	b) high
3. Enable	c) backward
4. Low	d) stiffness
5. Flexibility	e) longer
6. Shorter	f) disable

9. **Match the following terms with their definitions.**

1. Firm	a) is a person who is employed to operate or control a machine.
2. Service	b) an organization which sells or produces something or which provides a service, which people pay for.
3. Operator	c) a system or group of connected parts.
4. Finding	d) how fast something moves or happens.
5. Network	e) You can sometimes refer to an organization or private company as a particular service when it provides something for the public or acts on behalf of the government.
6. Speed	f) . an arrangement for what you intend to do or how you intend to do something

7. Plan	g) the information they get or the conclusions they come to as the result of an investigation or some research.

10. **Suffixes are used to form different parts of the speech. Use your dictionary to find the derivatives of the words. Translate the words into Russian.**

To transmit –

To receive –

To communicate –

To improve –

To invent –

11. **Divide the text "Communication systems and information theory" into logical parts and give subtitles to each part.**

12. **Retell the text using the titles.**

COMPREHENSION

13. **Read the text about Bluetooth technology and answer the questions.**

1. What is Bluetooth widely used for?
2. When did Ericsson come up with a concept to use a wireless connection?
3. How many companies formed Special Internet Group?
4. What fact shows that the Bluetooth SIG grew very rapidly?
5. What functions does the Bluetooth SIG perform?
6. Why was the Bluetooth standard named after the Danish king Harald Blatand?
7. What was the aim of Bluetooth technology?
8. What frequency band does Bluetooth use for its radio signals?

BLUETOOTH TECHNOLOGY

Bluetooth is widely used as a short range data communications platform for connecting many devices from mobile phones to headphones, and computer mice to computers for many applications including music and audio streaming. Discover how it works in our tutorial. Bluetooth

technology has now established itself in the market place enabling a variety of devices to be connected together using wireless technology.

Bluetooth technology has come into its own connecting remote headsets to mobile phones, but it is also used in a huge number of other applications as well.

In fact the development of Bluetooth technology has progressed so that it is now an integral part of many household items. Cell phones and many other devices use Bluetooth for short range connectivity. In this sort of application, Bluetooth has been a significant success.

The Bluetooth history dates back to 1994 when Ericsson came up with a concept to use a wireless connection to connect items such as an earphone and a cordless headset and the mobile phone. The idea behind Bluetooth (it was not yet called Bluetooth) was developed further as the possibilities of interconnections with a variety of other peripherals such as computers printers, phones and more were realized.

It was decided that in order to enable the development of Bluetooth technology to move forward and be accepted, it needed to be opened up as an industry standard. Accordingly, in Feb 1998, five companies (Ericsson, Nokia, IBM, Toshiba and Intel) formed the Bluetooth SIG - Special Interest Group. The history of Bluetooth shows the Bluetooth SIG grew very rapidly, because by the end of 1998 it welcomed its 400th member. The Bluetooth SIG also worked rapidly on the development of Bluetooth technology. Three months after the formation of the special interest group - it was not yet known as the Bluetooth SIG, the name Bluetooth was adopted.

The following year the first full release of the standard occurred in July 1999. The Bluetooth SIG performs a number of functions:

- Publish and update the Bluetooth specifications
- Administer the qualification programme
- Protect Bluetooth trademarks

• Evangelise Bluetooth technology

The Bluetooth SIG global headquarters is in Kirkland, Washington, USA and there are local offices in Hong Kong, Beijing, China; Seoul, Korea; Minato-Ku, Tokyo; Taiwan; and Malmo, Sweden.

The name of the Bluetooth standard originates from the Danish king Harald Blatand who was king of Denmark between 940 and 981 AD. His name translates as "Blue Tooth" and this was used as his nickname. A brave warrior, his main achievement was that of uniting Denmark under the banner of Christianity, and then uniting it with Norway that he had conquered. The Bluetooth standard was named after him because Bluetooth endeavours to unite personal computing and telecommunications devices.

The first release of Bluetooth was for a wireless data system that could carry data at speeds up to 721 Kbps with the addition of up to three voice channels. The aim of Bluetooth technology was to enable users to replace cables between devices such as printers, fax machines, desktop computers and peripherals, and a host of other digital devices. One major use was for wirelessly connecting headsets for to mobile phones, allowing people to use small headsets rather than having to speak directly into the phone.

Another application of Bluetooth technology was to provide a connection between an ad hoc wireless network and existing wired data networks.

The technology was intended to be placed in a low cost module that could be easily incorporated into electronics devices of all sorts. Bluetooth enables communications to be established between devices up to a maximum distance of around 100 meters, although much shorter distances were more normal.

Bluetooth is well established, but despite this further enhancements are being introduced. Faster data transfer rates, and greater flexibility. In addition to this efforts have been made to ensure that interoperation has been improved so that devices from different manufacturers can talk together more easily.

***14.*Read the text and make the list of facts and fiction about Bluetooth.**

BLUETOOTH FACT OR FICTION

Like many technologies on the market today, Bluetooth experienced its share of weirdness and wrong information. Are you ready to play Bluetooth: Fact or Fiction? Let's go!

Bluetooth technology was named after a 10th century Danish King.

Fact! The name Bluetooth comes from the 10th century Danish King Harald Blåtand or Harold Bluetooth in English. King Blåtand helped unite warring factions in parts of what are now Norway, Sweden and Denmark. Similarly, Bluetooth technology was created as an open standard to allow connectivity and collaboration between disparate products and industries.

Bluetooth was initially conceived as a replacement for RS-232 standard cables.

Fact! But its value, and huge success, came from creating a Personal Area Network (PAN) of devices, from light bulbs to headsets and everything in between.

Bluetooth was created by Hedy Lamarr, a famous actress and inventor.

Fiction (based on fact)! Hedy Lamarr developed spread spectrum and frequency hopping technology, which is incorporated in modern Bluetooth technology and essential for Adaptive Frequency Hopping, which is what makes Bluetooth a good-neighbor technology and limits interference.

A2DP, GATT, HID and BIP are all important Bluetooth profiles.

Fact! A2DP (Advanced Audio Distribution Profile) makes streaming stereo music possible. GATT (Generic Attribute Profile) allows developers to build unique profiles specific for their applications (Bluetooth fork, anyone?). HID (Human Interface Device Profile) makes your Bluetooth enabled mice and keyboards work effortlessly. BIP (Basic Imaging Profile) allows you to send images between devices (other phones, printers, even picture frames).

Bluetooth causes headaches.

Fiction! There is no clear evidence that radio frequency (RF) waves cause any harmful health effects.

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***15.*Write the translation of the text.**

MODERN LIGHT-WAVE COMMUNICATIONS TECHNOLOGY

Recently, the concept of using light pulses instead of electrical signals to transmit information was only that — a concept. Today, light-wave communications systems are among the most sophisticated transmission systems in the telecommunications network. They are at once efficient, versatile and relatively inexpensive to install and maintain.

The efficiency of light-wave systems is perhaps their most renowned quality. They carry enormous amounts of information over long distances at very high speeds. Consider, for example, the speed and capacity of the Bell System's long distance light-wave system. Light pulsing through a single, hair-thin glass fiber in this system can transmit *the entire contents of Webster's unabridged dictionary* — more than 2700 pages — over thousands of miles in only six seconds.

No less impressive than this tremendous speed and capacity is the versatility of light-wave systems. Because they are digital systems, they can transmit easily any of these types of information: voice signals, high-speed data signals, and television signals. Without undermining quality or efficiency, a single system can accommodate thousands of telephone conversations, and alternately handle data or video signals.

Finally, light-wave systems are inexpensive to install and operate compared to their wire-and-cable counterparts. Moreover, they allow considerable savings.

The entire contents of Webster's unabridged dictionary – полное содержание неадаптированного словаря Вебстера

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WRITING

16. **Think of an electronic communication device (TV, radio, mobile phone, computer, etc.) you use every day. Write about its use, advantages, disadvantages and your opinion of it.**

SPEAKING

17. **Quiz "What do you know about Information Communication Technologies?" Ask and answer the questions with your partner. Make up dialogues.**

1. What is radio communication?
2. Who were the founders of wireless communication?
3. What is A. Bell famous for?
4. Who invented the first electromagnetic telegraph?
5. What does the word "radio" mean in Latin??
6. What is Bluetooth widely used for?
7. What is the role of H. Hertz in the development of wireless communication?
8. What do you know of N. Tesla and his role in the advancement of radio'?
9. What was G. Marconi awarded the Nobel Prize for??
10. What technologies does ICT include?

UNIT 5. AUTOMATIC CONTROL SYSTEMS

Text 1.

AUTOMATION

PRE-READING

1. Answer the following questions.

1. What are the issues in automation?
2. What are the key factors to be considered for automation?

VOCABULARY

2. Learn terms from the text.

to suggest an idea to smb	натолкнуть на мысль
a weaving loom	ткацкий станок
a float-type controller	поплавковый регулятор
the centrifugal speed governor	регулятор скорости
transfer machining	механическая перестановка
control engineering	техника регулирования
a self-feeding process	процесс автоматической подачи
self-initiating	автоматическое включение
self-checking process	самопроверяющийся процесс
detect faults accurately	обнаруживать ошибки с большой точностью
above-mentioned advantages	вышеупомянутые достоинства
continuous cycle production	непрерывный производственный цикл
automatic aircraft pilot	автопилот самолета
to direct on the correct path	направлять по заданной траектории
ensure safe landing	обеспечивать мягкую посадку

READING

3. Read the text and answer the questions.

AUTOMATION

It is well known that since ancient times people have tried to construct automatic toys. Those toys were put into motion by hidden mechanisms of automatic devices. The mechanical wonders of the past indicated the road for developing automatic systems later. Clocks and watches, being the first automatic systems, suggested to people an idea of producing automata in industrial manufacture. The Frenchman Vaucanson built a weaving loom replacing fifty weavers. The talented Russian mechanic Iran Polzunov invented a float-type controller for his steam engine. Steam engines found universal application due to the invention of the centrifugal speed governor, designed by the English inventor James Watt. Soon automation spread to all technological spheres and became a moving force of technological advance.

So, automation deals with the theory and construction of control systems which can function without man's participation. It should be noted that modern automatic industrial process involves four independent components, each component becoming more powerful in the presence of the other. They are: transfer machining, automatic assembly, communication engineering and control engineering. These four components are linked together into a single process called automation. When two or more automatic machines are connected together with automatic controls, which may be mechanical, electrical, electronic or a combination of them, an automated control system is formed. This system creates a self-feeding, self-initiating and self-checking process.

It should be noted that electronics has greatly extended the range of automatic control and has made the processing of information rapid and automatic. Electronic devices are able to respond very quickly to signals and take measurements and detect faults very accurately. So, they can effectively control

many processes and machines working at high speeds. Due to the above-mentioned advantages automatic control systems find wide application in many fields of technology. Automatic controls relieve man of many monotonous activities. Besides, they can perform functions which are beyond the physical abilities of man.

People make great use of automation in industry; it is especially effective in continuous cycle production. Various kinds of electronic devices are applied in automatic aircraft pilots, as radio aids to air and marine navigation. Owing to automation special devices make precise calculations for space vehicle movement, help to launch missiles and to direct them on the correct path. Automatic interplanetary stations and space rockets are equipped with orientation systems, photo-television apparatus, special soft landing radio systems and movement control systems of high precision. These systems ensure safe returning and safe landing. Automation to be developed successfully has become one of the main factors of engineering progress today.

QUESTIONS:

1) How were the first automatic toys put into motion?

2) What were the first automatic systems?

3) Who was the first to show the advantages of automatic devices?

4) Due to what did steam engines find wide application?

5) What is automation?

6) What components does an automatic industrial process include?

7) What conditions can an automatic control system be formed under?

8) What processes does such system create?

9) What extended the range of automatic control?

10) What fields of technology are automatic control systems used in?

VOCABULARY WORK

4. Read, translate and memorize the following word combinations.

To put into motion; mechanical wonders; to suggest an idea to people; industrial manufacture; to invent a float-type controller; a steam engine; to find universal application; due to the invention; centrifugal speed governor; a moving force of technological advance; transfer machining; automatic assembly; communication engineering; control engineering; automatic controls; automatic control systems; to create a self-feeding, self-initiating and self-checking process; to extend the range of automatic control; to respond to signals quickly; to take measurements; to detect faults accurately; due to the above-mentioned advantages; continuous cycle production; automatic aircraft pilot; radio aids; air and marine navigation; owing to automation; to make precise calculations; space vehicle movement; to launch and direct missiles on the correct path; to be equipped with orientation systems; movement control systems of high precision; to ensure safe returning and safe landing.

5. Find in text the English equivalents of the following phrases.

Автоматизированная система управления; приводить в движение; натолкнуть на мысль; промышленное производство; изобрести поплавковый регулятор; паровой двигатель; благодаря изобретению регулятора скорости; движущая сила технического прогресса; механическая перестановка; автоматическая сборка; техника связи; техника регулирования; создавать процесс автоматической подачи; автоматическое включение; расширять диапазон автоматического управления; быстро реагировать; обнаруживать погрешности с высокой точностью; благодаря вышеупомянутым достоинствам; непрерывный производственный цикл; автопилоты; радиосредства; выполнять вычисления; полеты космических кораблей; направлять ракеты по заданной траектории; системы управления полетом высокой точности; обеспечивать мягкую посадку.

6. Find out the key words of the text.

7. **Use the key words of the text to make up the outline of the text.**
8. **Write out the main idea of the text. Be ready to speak about it.**
9. **Give the summary of the text.**

COMPREHENSION

10. **Read and translate the text, look up the meaning of new words and expressions in a dictionary.**

TYPES OF AUTOMATION

Basic automation. Basic automation takes simple, rudimentary tasks and automates them. This level of automation is about digitizing work by using tools to streamline and centralize routine tasks, such as using a shared messaging system instead of having information in disconnected silos. Business process management (BPM) and robotic process automation (RPA) are types of basic automation.

Process automation. Process automation manages business processes for uniformity and transparency. It is typically handled by dedicated software and business apps. Using process automation can increase productivity and efficiency within your business. It can also deliver new insights into business challenges and suggest solutions. Process mining and workflow automation are types of process automation.

Integration automation. Integration automation is where machines can mimic human tasks and repeat the actions once humans define the machine rules. One example is the "digital worker." In recent years, people have defined digital workers as software robots that are trained to work with humans to perform specific tasks. They have a specific set of skills, and they can be "hired" to work on teams.

Artificial intelligence (AI) automation. The most complex level of automation is artificial intelligence (AI) automation. The addition of AI means that machines can "learn" and make decisions based on past situations. For example, in customer service, virtual assistants powered can reduce costs while empowering both customers and human agents, creating an optimal customer service experience.

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11. **Tell in English about different types of automation.**
12. **Translate the following text into English. Find some more information in the Internet.**

ПРИНЦИПЫ АВТОМАТИЗАЦИИ ПРОЦЕССОВ

Несмотря на то, что автоматизация процессов может выполняться на различных уровнях, принципы автоматизации для всех уровней и всех видов процессов будут оставаться едиными. Это общие принципы, которые задают условия эффективного выполнения процессов в автоматическом режиме и устанавливают правила автоматического управления процессами.

Основными принципами автоматизации процессов являются:

- *принцип согласованности*. Все действия в автоматизируемом процессе должны быть согласованы между собой и со входами и выходами процесса. В случае рассогласования действий может произойти нарушение выполнения процесса.

- *принцип интеграции*. Автоматизируемый процесс должен иметь возможность интегрироваться в общую среду организации. На различных уровнях автоматизации интеграция выполняется по-разному, но суть принципа остается неизменной. Автоматизация процессов должна обеспечивать взаимодействие автоматизируемого процесса с внешней средой (по отношению к этому процессу).

- *принцип независимости исполнения*. Автоматизируемый процесс должен выполняться самостоятельно, без участия человека, либо с минимальным контролем со стороны человека. Человек не должен вмешиваться в процесс, если процесс выполняется в соответствии с установленными требованиями.

Text 2.

ELEMENTS AND STRUCTURE OF AUTOMATIC CONTROL SYSTEMS

PRE-READING

1. Answer the following questions.

1. What automatic control systems do you know?
2. What is the role of humans in automation?

VOCABULARY

2.Practice reading the following words and phrases.

physical variables	физические переменные (величины)
process control systems	системы управления (производственным) процессом
reference input / driver	задающее устройство
an error detector	прибор по обнаружению ошибки
a controlled quantity	управляемая величина
feedback path elements	элементы обратной связи
to supply a feedback signal	поставлять сигнал обратной связи
transducers	преобразователи
servomotors	сервомоторы
a variable resistance	переменное сопротивление
to cover a lot of spheres	охватывать многие области

READING

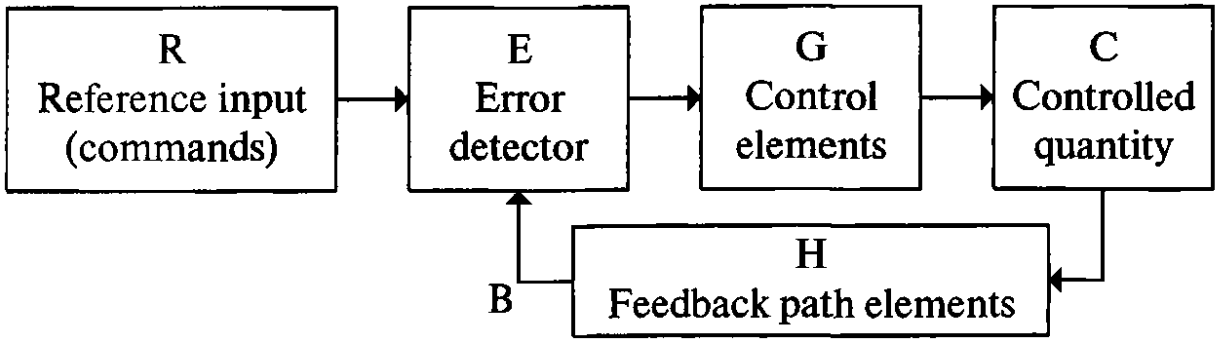
3.Read the text and tell about the constituent elements of automatic control systems. Answer the questions.

ELEMENTS AND STRUCTURE OF AUTOMATIC CONTROL SYSTEMS

Automatic control is the use of means which can maintain physical variables, such as temperature or pressure, at a desired level automatically. Systems which perform the control of physical variables are called automatic control systems (ACS).

Automatic control systems may be classified as servo-mechanisms, process control systems and regulators, but whatever the classification be, the same principles of operation are common to them all. Every ACS should contain five main components. They are: a driver or reference input, an error detector, control elements, a controlled quantity and feedback path elements. The basic control system operation may be described by the simple block diagram:

The reference input or driver sets the desired level or position of controlled quantity C in this system. 77ie controlled quantity C is the resulting level or position of the variable parameter, that is the position to be controlled by this ACS. The feedback path elements H supply a feedback signal B that indicates the level of the controlled quantity C. The error detector receives the feedback signal B and compares it with the input command signal R; any error (or difference between B and R) produces an output or resulting signal E. Control elements G receive, amplify and transform the output signal E to maintain the controlled quantity at the desired level.



To produce an automatic control system it is necessary to use a lot of various elements. These are logical elements, relays, potentiometers, magnetic amplifiers, transducers and other devices. The basic components of every ACS are logical elements which may be deduced to transducers and servomotors. Relays are usually sensitive

devices that can control the action of large or remote apparatus in circuits. A potentiometer consists basically of a variable resistor. If connected to a circuit the variable resistance makes it possible to vary the amount of voltage supplied to a load. Magnetic amplifiers belong to a large group of magnetically controlled devices. The principle of their operation is based on the process of magnetizing a core by varying a magnetomotive force periodically. Transducer is known as a converting device. Many well-known devices act as transducers, for example, an electric motor acts as a transducer converting electrical energy into mechanical one.

The application of automatic control systems covers a lot of spheres, ranging from the use for the guidance of space vehicles to the control of industrial processes.

QUESTIONS:

1. What is automatic control?
2. What are automatic control systems?
3. How can they be classified?
4. What components does an ACS contain?
5. What is the function of a driver?
6. Try to describe the basic control system operation.
7. What are the basic elements of any automatic control system?
8. What is the function of relays?
9. What is the principle of amplifiers operation based on?
10. What do transducers serve for?

VOCABULARY WORK

4. Find in Text 2 the English equivalents of the following phrases.

Поддерживать физические переменные величины; желаемый уровень; задающее устройство; прибор по обнаружению ошибки; управляемая величина;

элементы обратной связи; подавать сигнал обратной связи; любая погрешность; усиливать; преобразовывать; преобразователи; чувствительные приборы; переменное сопротивление; менять величину напряжения, подаваемого к нагрузке; принцип действия; периодическое намагничивание сердечника; охватывать много областей; наведение космических летательных аппаратов; управление производственными процессами.

5. Find words in Texts 1 and 2 that are close in meaning to the proposed words.

Nouns: regulator (2); motor; branch (2); means; aeroplane; movement; concept; production; motor; use; progress; rate; type; mistake; failure; value; standard; element; road; work (2); instruction; convener; number.

Verbs: to build (2); to mean; to include; to connect; to widen; to react; to find out; to manage (2); to keep up; to provide; to install (2); to show; to get (2); to fabricate (2); to use (2); to intensify; to convert (2); to change; to operate.

Adjectives: quick; up-to-date; broad; on-going; particular; main; different; distant; feasible; accurate.

6. In pairs, take turns to interview your partner about understanding the elements and structure of automatic control systems. What questions do you think are the most relevant?

7. Retell the Text using words and phrases on specialty.

COMPREHENSION

8. **Read the Text, divide it into semantic parts and title them.**

FROM THE HISTORY OF AUTOMATIC CONTROL THEORY

The concept of control and the use of control devices were known long ago. Simple control systems with an input signal controlling an output element have been used by people for a long time. In recorded history it is found that the Romans invented a

water-level control device 2000 years ago.

The mathematical foundations for control theory have been laid by J. Courier and P. Laplace. Research work in analytical dynamics was carried out by A. Routh. A. Lyapunov was the first to develop the theory of stability of automatic control systems.

Real development of automatic control theory began in the 1920s. World War I brought a tremendous impetus for the advancement of control. Such problems as the automatic bombing and control systems for anti-aircraft guns required fundamental theory and complex equipment. To meet these requirements investigations in the field of automation were accelerated.

Nowadays automatic control systems play an important role. There has been an enormous growth in the application of controllers in technology and everyday life. Domestically, automatic controls in heating and air conditioning systems regulate the temperature and humidity. Industrially, they are employed in quality control of manufactured products, power stations, etc. In space technology and weapon systems they appear in the form of guidance systems, fire control systems, etc. It is automation that ensures speed, accuracy, reliability, high quality and economy of technological processes.

Automation control is irreplaceable where it is necessary to maintain various physical properties at a desired level. Among many physical properties that can be controlled there are temperatures and pressures in chemical industry, moisture content in textile industry, thickness of insulation around wires in electrical engineering.

9. Read the Text again and make an abstract by expanding the information on each item of the Plan made in exercise 8.

10. Perform a written translation of texts A and B according to the options.

Text A. CONTROL SYSTEMS CLASSIFICATION

As it is known control systems are classified according to the degree of their automation. A control system is called automatic if the basic functions of control are performed without the participation of man, that is automatically. Completely automated control systems are de- fined as closed-loop systems. Partially automated control systems are termed open-loop ones.

A closed-loop control system or feedback system automatically controls and modifies its own operation by responding to data generated by the system itself. The example of a closed-loop control system is a switch of a high-speed printer, used in computer systems. The switch finds if there is paper in the printer. If the paper runs out, the switch signals the system to stop operation.

An open-loop system does not provide for its own control or modification. It must be controlled by people. The example is the operation of a printer having no switch. In this case a human operator must notice when the paper runs out and signal the system to stop printing.

The former system is automatically controlled by self-regulation, the letter one being controlled by man. This difference determines their application. Open systems are used for stabilization and program control. Closed systems replace man in hard and dangerous work.

Text B. RELAYS

Today forms and applications of electric relays are numerous and varied. Having improved relays scientists received a more reliable form of control. As it is known there is a large range of electric relays which are utilized to operate switchgear, totalisator, road traffic signals and certain types of automatic telephone equipment.

Sometimes it is necessary to operate a circuit by reversing a current in the actuating circuit. This is done by using a polarized relay. The special feature of this relay is the employment of a permanent magnet. Giving the armature a definite polarity, the permanent magnet makes it possible to control the direction of the armature movement when a current passes through the relay coils. This permanent magnet is necessary to maintain the same polarity at each end of the armature. When energised with the poles directed to the north and south, the relay attracts one end of the armature and repels the other one.

Using this type of relay engineers often employ it for the remote control of wireless sets and similar purposes, when needed, to economise energy of batteries.

When used in such applications as temperature control, coil winding machines, etc., another type of relay is very effective. It is a plug-in relay. These relays are medium speed devices. Requiring relatively low coil power they are preferable in many applications.

11.Choose definitions for the given words.

1. Transducer - a) an instrument for measuring, comparing or controlling electric voltage.

2. Potentiometer - b) a device used to increase the strength of an electric signal.

3. Relay - c) any machine part that communicates motion to another part.

4. Amplifier - d) a mechanism for controlling the movement of machinery, the flow of liquids, gases, electricity, steam, etc.

5. Detector - e) any device that transmits energy from one system to another or converts the energy in form.

6. Driver - f) an electromagnetic device controlling a larger current or activating other devices in the same or another electric circuit.

7. Regulator - g) an apparatus for indicating the presence of smth., as electric waves.

8. Feedback - h) a defect in a circuit, which prevents the current from following the intended course.

9. Assembly - i) the transfer of part of the output of an active circuit or device back to the input.

10. Fault - j) a fitting together of parts to make the whole.

12. **Fill in the gaps in the sentences and translate them into Russian.**

1. We suppose automation has become ___of technologicalprogress.

a) a mechanical wonder;

b) a moving force;

c) an electromotive force;

d) a self-checking process.

2. James Watt is known to invent ____

a) a load-type controller;

b) self-initiating device;

c) centrifugal speed governor;

d) weaving loom.

3. Automatic control is sure to have made the of information rapid and accurately.

a) collecting;

b) processing;

c) storing;

d) perfecting.

4. It is known that automatic control system is formed by connecting automatic machines with _____

a) self-feeding process;

b) automatic assembly;

c) control engineering;

d) automatic controls.

5. Many special devices make highly precise calculations ____ automation.

a) due to;

b) according to;

c) because of;

d) in spite of.

6. Increasing the strength of current power____are widely usedin voltage dividers.

a) detectors;

b) potentiometers;

c) transducers;

d) amplifiers.

7. Automatic control systems__people of many monotonous activities.

a) require;

b) relieve;

c) revise;

d) relax.

8. Without knowing the basic elements of the ACS it is impossible to regulate __it components.

a) completely;

b) independently;

c) properly;

d) mechanically.

9. _____ are said to be electromagnetic devices controlling theaction of other devices in a circuit. They can also operate as switches.

a) capacitors;

b) conductors;

c) resistors;

d) relays.

10. _____the stability of a feedback path an engineer could perfect the stability of the whole system.

a) being improved;

b) having improved;

c) having been improved;

d) to improve.

SPEAKING

13.Make up a presentation on different aspects of automation.

- Elements and Structures of Automatic control Systems
- The History of Automatic control Systems
- Control Systems Classification
- Automation Technologies
- Robot Applications

UNIT 6. NANOTECHNOLOGIES

Text 1.

WHAT IS NANOTECHNOLOGY?

PRE-READING

1. Answer the following questions.

1.What kind of engineering is nanotechnology?

2.What does the prefix “nano” mean?

2. Practice reading the following words.

atom	['ætəm]	chemical	['kemikəl]
molecule	['molikju:l]	catalyst	['kætəlist]
synthesis	['sinθisis]	nanostructure	[nænəu'strΛktʃə]
nanometer	[nænəu'mi:tə]	toxicity	[ta:k'sisəti]

VOCABULARY

3. Study and remember the words.

Dimension	[dɪˈmenʃn]	измерение
interaction	[ɪntərˈækʃn]	взаимодействие
Catalyst	[ˈkætəlɪst]	катализатор
layer	[ˈleɪə]	слой
Solid	[ˈsɒlɪd]	твердое тело
Scale	[skeɪl]	уровень
diverse	[daɪˈvɜːs]	разнообразный

extension	[ɪksˈtenʃn]	расширение
range	[reɪndʒ]	спектр
Toxicity	[tɒkˈsɪsɪtɪ]	токсичность
Speculation	[spekjʊˈleɪʃn]	предположение
to warrant	[ˈwɒrənt]	гарантировать
Dwarf	[dwɔːf]	карлик
Continuum	[kənˈtɪnjʊəm]	сплошная среда
Preponderance	[prɪˈpɒndərəns]	преобладание
Ductile	[ˈdʌktaɪl]	пластичный, вязкий
Subtle	[sʌtl]	едва различимый
Refine	[rɪˈfaɪn]	усовершенствовать
Doomsday	[ˈduːmzdeɪ]	конец света
Confinement	[kənˈfaɪnmənt]	ограничение
Alter	[ˈɔːltə]	изменять

READING

4. Read the text and answer the questions.

WHAT IS NANOTECHNOLOGY?

Nanotechnology, shortened to “nanotech”, is the study of the controlling of matter on an atomic and molecular scale. Nanotechnology deals with structures of the size 100 nanometers or smaller in at least one dimension, and involves developing materials or devices within that size. Nanostructures are assembled a single atom, molecule, or atomic layer at a time, as part of a vast new field of research in nanomaterials synthesis and assembly. In other words it is the engineering of functional systems at molecular scale. It offers ways to create smaller, cheaper, lighter and faster devices that can do more and cleverer things, use less raw materials and consume less energy.

Nanotechnology originates from the Greek word meaning “dwarf”. “Nano” is a prefix meaning one-billionth. A nanometer is one-billionth of a meter or it is about one hundred thousandth of the width of a hair! The world of atoms and molecules could not be visualized and managed until a new generation of microscopes were invented in 1980s in IBM in Switzerland.

Generally, structures smaller than a nanometer tend to behave much like individual atoms, while materials that are hundreds of nanometers or greater in size exhibit properties of the continuum. Nanoscale properties and behaviors can be quite different as the result of unique physical and chemical interactions. The preponderance of surfaces and interfaces, and the physical confinement of matter and energy, can alter nearly all properties of materials (physical, chemical, optical, etc.), and thus produce extraordinary new behaviors. Examples include generating light from dark materials, improving efficiencies of catalysts by orders of magnitude, and turning soft and ductile materials like gold into solids with hardness equivalent to bearing steel.

The final ingredient to nanotechnology is the ability to characterize and predict nanoscale properties and behavior. New experimental tools that are able to “see”, “touch”, and measure the behavior of individual nanostructures allow scientists and engineers to identify subtle differences in structure and properties that control nanoscale properties. By coupling new experimental techniques with advanced computational tools, researchers can develop, verify, and refine models and simulations that will allow the full potential for nanotechnology to be explored.

There has been much debate on the future implications of nanotechnology. Nanotechnology has the potential to create many new materials and devices with a vast range of applications, such as in medicine, electronics and energy production. On the other hand, nanotechnology raises many of the same issues as with any introduction of new technology, including concerns about the toxicity and environmental impact of nanomaterials, and their potential effects on global economics, as well as speculation about various doomsday scenarios. These concerns have led to a debate among

advocacy groups and governments on whether special regulation of nanotechnology is warranted.

QUESTIONS:

1. What structures are investigated by nanotechnology?
2. What advantages does nanotechnology offer in creating new products?
3. What is the origin of the word “nanotechnology”?
4. What basic inventions influenced the development of the new science?
5. Why do nanomaterials behave in other way than ordinary structures?
6. What is the extraordinary feature of nanotechnology?
7. What fields of science is nanotechnology applied in?

VOCABULARY WORK

5. **Find English equivalents to the following word combinations in the text.**

1) Молекулярный уровень;

2) атомный слой;

3) синтез и сборка;

4) сырьё;

5) потреблять энергию;

6) толщина волоса;

7) проявлять свойства;

8) изменять свойства материалов;

9) по порядку величины;

10) несущая сталь;

11) при соединении;

12) последствия нанотехнологии;

13) поднимают многие проблемы;

14) воздействие наноматериалов на окружающую среду;

15) сценарий конца света;

16) пропагандистские группы.

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

1) Substance;

2) level;

3) huge;

4) use;

5) show;

6) feature;

7) limitation;

8) flexible;

9) connecting;

10) improve;

11) investigate;

12) effects of smth;

13) problems;

14) discussion.

7. Insert the necessary word in the gap.

1) Nanotechnology is the engineering of functional systems at the … scale.
   a) nuclear;
   b) electron;
   c) particle;
   d) molecular.
2) Due to nanotechnology we can create things … less energy.
   a) consuming;
   b) producing;
   c) converting;
   d) generating.

3) Scientists could … the world of atoms owing to the invention of new microscopes.
   a) verify;
   b) offer;
   c) visualize;
   d) penetrate.
4) New … of microscopes helped advance the science of nanotechnology.
   a) gravitation;
   b) generation;
   c) production;
   d) contribution.
5) The science of nanotechnology attracted attention of scientists all over the world … its limitless possibilities.
   a) in spite of;
   b) because of;
   c) instead of;
   d) due to.

8. Suffixes are used to form different parts of the speech. Use your dictionary to find the derivatives of the words. Translate the words into Russian.

To accept –

To reduce –

To disperse –

To emerge –

To adapt –

9. Find out the key words of the text.

10. Use the key words of the text to make up the outline of the text.

11. Write out the main idea of the text. Be ready to speak about it.

12. Give the summary of the text.

COMPREHENSION

13. Give the gist of the following text.

Fundamental Concepts of Nanoscience and Nanotechnology

It's hard to imagine just how small nanotechnology is. One nanometer is a billionth of a meter, or 10^{-9} of a meter. Here are a few illustrative examples:

- There are 25,400,000 nanometers in an inch.
- A sheet of newspaper is about 100,000 nanometers thick.
- On a comparative scale, if a marble were a nanometer, then one meter would be the size of the Earth.

Nanotechnology involves the ability to see and to control individual atoms and molecules. Everything on Earth is made up of atoms - the food we eat, the clothes we wear, the buildings and houses we live in, and our own bodies. But something as small as an atom is impossible to see with the naked eye. In fact, it's impossible to see with the microscopes typically used in a high school science classes. The microscopes needed to see things at the nanoscale were invented relatively recently - about 30 years ago.

Once scientists had the right tools, such as the scanning tunneling microscope (STM) and the atomic force microscope (AFM), the age of nanotechnology was born.

Although modern nanoscience and nanotechnology are quite new, nanoscale materials were used for centuries. Alternate-sized gold and silver particles created colors in the stained glass windows of medieval churches hundreds of years ago. The artists back then just didn't know that the process they used to create these beautiful works of art actually led to changes in the composition of the materials they were working with.

Today's scientists and engineers are finding a wide variety of ways to deliberately make materials at the nanoscale to take advantage of their enhanced

properties such as higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity than their larger-scale counterparts.

Downloaded from: Nanotechnology. URL: https://www.nano.gov/nanotech-101/what/definition

14. Translate the following text into English.

Видели ли вы когда-нибудь монитор, толщина которого меньше миллиметра? А несгораемую и непромокаемую бумагу? Или одежду, которую невозможно испачкать? Это не фантастика! Это то, что ожидает нас в недалеком будущем. Такие необычные предметы могут подарить человеку нанотехнологии. То, что технология – это способ производства какого-либо объекта, знает каждый. А вот что означает приставка «нано»? «Нано» – одна миллиардная доля чего-либо. Один нанометр – миллиардная доля метра. 1нм = 0,000000001 м. Попробуем представить себе объекты такого размера. Нанометр меньше метра примерно настолько, насколько грецкий орех меньше земного шара. Размеры в несколько нанометров имеют большие молекулы, например, белки. Атомы и обычные молекулы меньше, они измеряются десятыми долями нанометров. Нанотехнология – комплекс методов, который позволяет создавать объекты наноразмеров (от 1 до 100 нм). Такие объекты имеют особые свойства. Именно эти свойства наноматериалов позволят использовать их для новейших научных достижений. Уже сейчас нанотехнологии – наиболее перспективное и финансируемое направление в мировой науке.

Downloaded from: http://www.festivalnauki.ru/statya/3477/chto-takoe-nanotehnologii

SPEAKING

15. Find more information in the Internet and continue the sentence:

Nanotechnology, a new field of science, is a technology that ….

Be ready to speak about 3 minutes.

Text 2.

THE HISTORY OF NANOTECHNOLOGY

PRE-READING

1.Answer the following questions.

1. Is nanotechnology a new science?

2. Where did it come from?

2.Practice reading the following words.

microscope	['maikrəskəup]
oxide	['a:ksaid]
gravity	['græviti]
quantum	['kwa:ntəm]
carbon	['ka:bən]

VOCABULARY

3.Study the vocabulary list.

Precise [prɪˈsaɪs]	точный
Fullerene [fəˈlɪriːn]	фуллерен
Plausible [ˈplɔːzəbl]	правдоподобный
Enhance [ɪnˈhɑːns]	улучшать
Van der Vaals attraction [əˈtrækʃn]	Ван-дер Ваальсовы силы
Accusation [ækjʊˈzeɪʃn]	обвинение
Cluster [ˈklʌstə]	группа
Entity [ˈentɪtɪ]	сущность, элемент
Carbon [ˈkɑːbən]	углеродные
Nanotubes [nænəˈtjuːb]	нанотрубки

Deliberate	[dɪˈlɪbərɪt]	целенаправленный
Evaluate	[ɪˈvæljʊeɪt]	оценивать, рассматривать

READING

4. Read the text and answer the questions.

THE HISTORY OF NANOTECHNOLOGY

Nanotechnology, in its traditional sense, means building things from the bottom up, with atomic precision. The first use of the concepts found in 'nano-technology' (but pre-dating use of that name) was in "There's Plenty of Room at the Bottom," a talk given by physicist Richard Feynman at an American Physical Society meeting at Caltech on December 29, 1959. Feynman described a process by which the ability to manipulate individual atoms and molecules might be developed, using one set of precise tools to build and operate another proportionally smaller set, and so on down to the needed scale. In the course of this, he noted, scaling issues would arise from the changing magnitude of various physical phenomena: gravity would become less important, surface tension and van der Waals attraction would become increasingly more significant, etc. This basic idea appeared plausible, and exponential assembly enhances it with parallelism to produce a useful quantity of end products.

The term "nanotechnology" was defined by Tokyo Science University Professor Norio Taniguchi in a 1974 paper as follows: "'Nano-technology' mainly consists of the processing of, separation, consolidation, and deformation of materials by one atom or by one molecule."

In the 1980s the basic idea of this definition was explored in much more depth by Dr. K. Eric Drexler, who promoted the technological significance of nano-scale phenomena and devices through speeches and the books, and so the term acquired its current sense. "Engines of Creation: The Coming Era of Nanotechnology" (1986) is considered the first book on the topic of nanotechnology. When Dr. K. Eric Drexler

popularized the word 'nanotechnology', he was talking about building machines on the scale of molecules, a few nanometers wide — motors, robot arms, and computers, far smaller than a cell. Drexler spent the next ten years describing and analyzing these incredible devices, and responding to accusations of science fiction.

Two approaches are used in nanotechnology. In the “bottom-up” approach, materials and devices are built from molecular components which assemble themselves chemically by principles of molecular recognition. In the “top-down” one, nano-objects are constructed from larger entities without atomic-level control.

Nanotechnology and nanoscience got started in the early 1980s with two major developments; the birth of cluster science and the invention of the scanning tunneling microscope (STM). This development led to the discovery of fullerenes in 1985 and carbon nanotubes a few years later. In another development, the synthesis and properties of semiconductor nanocrystals was studied; this led to a fast increasing number of metal and metal oxide nanoparticles and quantum dots. The atomic force microscope (AFM or SFM) was invented six years after the STM was invented. Combined with refined processes such as electron beam lithograthy and molecular beam epitaxy, these instruments allow the deliberate manipulation of nanostructures, and lead to the observation of novel phenomena.

In 2000, the United States National Nanotechnology Initiative was founded to coordinate Federal nanotechnology research and development and is evaluated by the President's Council of Advisors on Science and Technology.

QUESTIONS:

1. What is nanotechnology in its traditional sense?
2. Who was the first to describe the theory of nanotechnology?
3. What is the role of Drexler in the advancement of nanotechnology?

4. When did the nanoscience start?
5. What inventions contributed to the development of nanotech?
6. What are the two main approaches in nanotechnology?

VOCABULARY WORK

5.Translate the following word combinations into Russian.

1.Atomic precision;

2. the ability to manipulate individual atoms and molecules;

3.surface tension;

4. useful quantity of end products;

5.the term acquired its current sense;

6.on the scale of molecules;

7.far smaller than a cell;

8. principles of molecular recognition;

9.properties of semiconductor nanocrystals;

10.the observation of novel phenomena.

6. Find English equivalents to the following word combinations in the text.

1. одиночные атомы;

2. проблема масштабирования;

3. экспоненциальная сборка;

4. отвечая на обвинения;

5. подход «снизу – вверх»;

6. подход «сверху – вниз»;

7. групповая наука;

8. сканирующий туннельный микроскоп;

9. металооксидные наночастицы квантовых точек;

10. атомно-силовой микроскоп.

7. **Find the words opposite in meaning in the text.**

1. inaccurate;
2. similar;

3. useless;
4. relaxation;
5. connection;
6. surface;
7. miserable;
8. narrow;
9. late;
10. aimless;
11. familiar.

8. Mark the following sentences True or False.

1. The classical theory of nanotechnology is based on the "top-down" approach.
2. The American physicist Richard Feynman was the first to describe the fundamental concepts of nanotechnology.
3. Nanotechnology is supposed to appear in 1980.
4. R. Dexler worked out the technology that allowed him to build new devices at molecular scale.
5. The invention of AFM led to the discovery of nanotubes and the research of semiconductor nanocrystals.

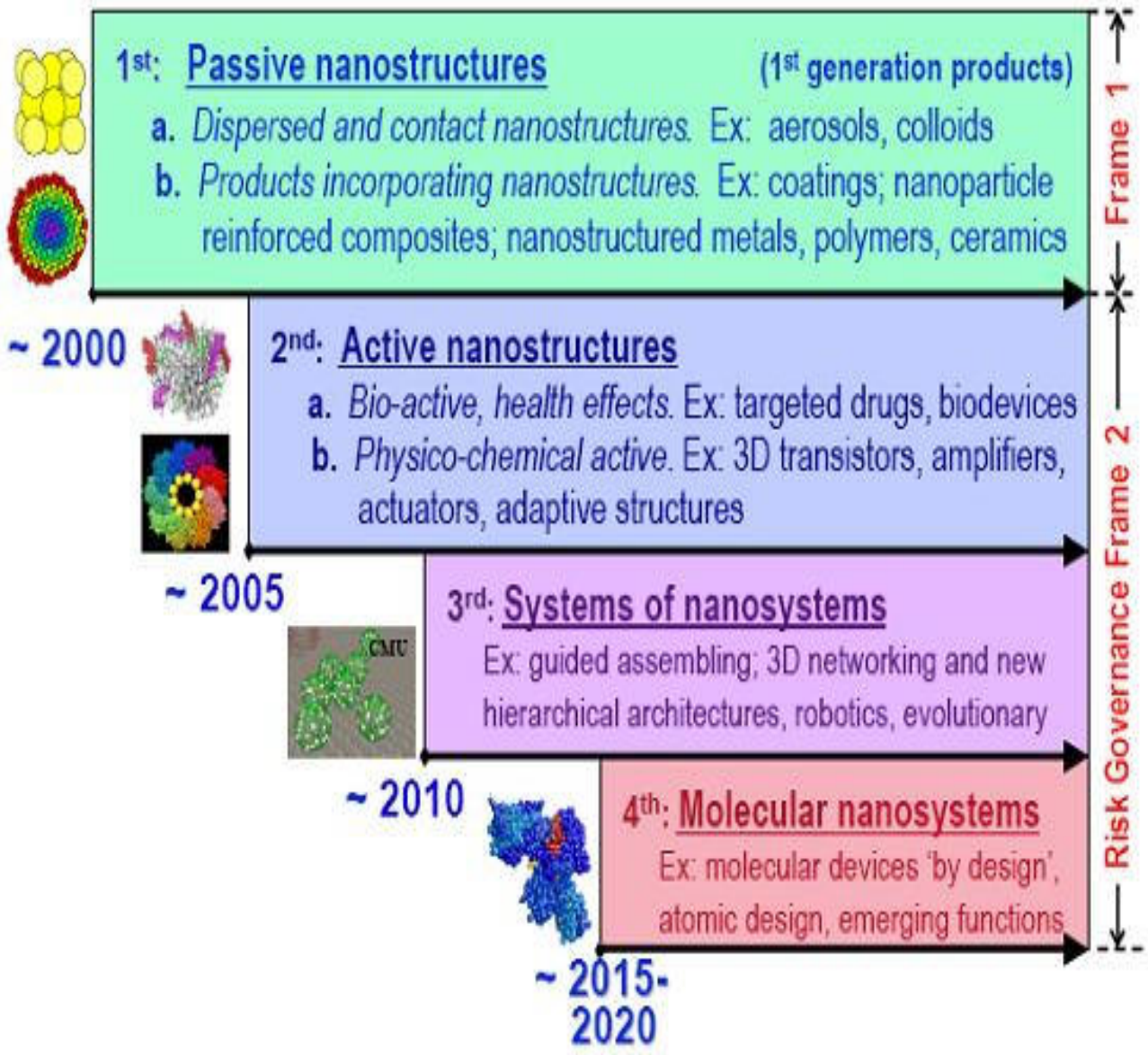
9. Divide the text into logical parts and give subtitles to each part.

10. Retell the text.

11. Give the written translation of the text in Russian. Find some more information about the history of Nanotechnology.

Four Generations

Mihail Roco of the U.S. National Nanotechnology Initiative has described four generations of nanotechnology development.



The current era, as Roco depicts it, is that of passive nanostructures, materials designed to perform one task. The second phase, which we are just entering, introduces active nanostructures for multitasking; for example, actuators, drug delivery devices, and sensors. The third generation is expected to begin emerging around 2010 and will feature nanosystems with thousands of interacting components. A few years after that, the first integrated nanosystems, functioning (according to Roco) much like a mammalian cell with hierarchical systems within systems, are expected to be developed.

12. Translate the following text into English and memorize the important dates.

Даты важнейших открытий

Наиболее выдающиеся достижения в области нанотехнологий отмечены Нобелевскими премиями

по физике:

- 1985 – за открытие квантового эффекта Холла;
- 1986 – за создание методов электронной и туннельной микроскопии высокого разрешения;
- 1998 – за открытие дробного квантового эффекта Холла;
- 2000 – за создание полупроводниковых гетероструктур и разработку полупроводниковых интегральных схем;
- 2010 – за исследования графена.

по химии:

- 1996 - за открытие фуллеренов;
- 1998 - за развитие теории функционала плотности и разработку вычислительных методов квантовой химии;
- 2000 - за открытие проводимости в полимерах;
- 2008 - за открытие и разработку методов использования зеленого флуоресцентного белка.

SPEAKING

***13.*Make up the presentation about the most important discoveries in the field of nanotechnology or the most famous physicists in nanoscience. Choose one of the discoveries or scientists to present.**

14. Quiz "What do you know about Nanotechnologies?" Ask and answer the questions with your partner. Make up dialogues.

1. What is the origin of the word "nanotechnology"?
2. What basic inventions influenced the development of the new science?
3. Why do nanomaterials behave in other way than ordinary structures?
4. What is the extraordinary feature of nanotechnology?
5. What fields of science is nanotechnology applied in?
6. What are the four generations of nanotechnology?
7. When did the nanoscience start?
8. What inventions contributed to the development of nanotech?
9. What are the two main approaches in nanotechnology?
10. Give examples of nanoproducts,

SUPPLEMENTARY READING

- **Read and translate the texts to find the additional information. Write down the key words and make up the summaries of the texts.**

Text 1. Antenna cable analyzer makes measurements easy

Measuring antenna cables is never easy. A variety of parameters needs to be measured and access is often limited. However, the need to good accurate antenna cable measurements is necessary when installing and maintaining a variety of equipment from mobile base stations to broadcast transmitters, PMR stations and a variety of receiving applications.

The key is measuring antenna cables is to be able to perform one-port measurements quickly and correctly the first time. That is exactly what network operators, infrastructure manufacturers and their service providers can do with the new handheld R&S Cable Rider ZPH cable and antenna analyzer from Rohde & Schwarz. With its fast measurement speed, intuitive operation and long battery life, it is ideal for use in the field.

Mobile World Congress, Barcelona 2017 — The handheld R&S Cable Rider ZPH cable and antenna analyzer helps infrastructure manufacturers and network operators efficiently install and maintain the steadily increasing number of mobile communications antenna systems. Where the R&S Cable Rider ZPH really stands out is its speed. With a measurement speed of 0.3 milliseconds per data point, it is significantly faster than other instruments. Featuring the fastest boot and warm-up time on the market, the analyzer allows users to start taking fast measurements just over a minute after switching on the R&S Cable Rider ZPH. Moreover, there is no requirement for calibration due to temperature and frequency changes, which saves time.

Another timesaving feature is the use of the wizard function that guides users through measurements in easy-to-follow steps. All settings and measurement steps can be preconfigured. Field technicians only need to execute the test sequences as shown on

the display. The wizard helps inexperienced field technicians to avoid operating mistakes when performing antenna and cable measurements. Since there is no need to change settings manually for different measurements, the analyzer reduces test time during installation and maintenance.

The R&S Cable Rider ZPH is ideal for use in the field. Thanks to its light weight of only 2.5 kilograms and a battery life of nine hours, users can handle a full day's work without interruption. Users will not be delayed due to the battery running down in the middle of a measurement. Furthermore, the analyzer has a large color touchscreen with familiar smartphone-like operation. For example, markers can be placed by double tapping signals on the display. The analyzer can also be operated via the extra-large, widely spaced keys that allow easy handling even when the user wears heavy-duty work gloves.

The R&S Cable Rider ZPH base unit covers a frequency range from 2 MHz to 3 GHz. Extending the frequency range to 4 GHz is straightforward with the R&S ZPH-B4 option, which is enabled via a key code.

Source; http://www.radio-electronics.com/news/antennas-propagation/antenna-cable-analyzer-makes-measurements-easy-8135

Text 2. Signal propagation for satellites

The effects of the atmosphere on satellite signals

Satellites are widely used these days for everything from navigation, in the case of GPS, satellite television broadcasting, communications, mobile phone technology, Internet broadband weather monitoring and much more.

Satellites normally use frequencies that are in excess of 500 MHz where the signals are not unduly affected by the ionosphere or troposphere. However, some effects can be noticed and are important, especially when planning, installing or setting up a satellite system.

Ground to satellite paths

When signals travel from the ground up to the satellite they pass through four main regions. These are the troposphere, above which is region that is often termed inner free space which is above the troposphere and below the ionosphere. The next region is the ionosphere, and finally there is the outer free space.

There are a number of different of effects that are introduced by these regions. Transmission in free space has unity refractive index and is loss-less (apart from the spreading effect that reduces the signal power over a fixed area with distance away from the source, but no power is actually lost).

The troposphere and ionosphere have refractive indices that differ from unity. The troposphere is greater than unity and the ionosphere is less than unity and as a result refraction and absorption occur. The inner free space region also has little effect.

Faraday rotation

A further effect that is introduced by the ionosphere is known as Faraday rotation which results from the fact that the ionosphere is a magneto-ionic region. The Faraday rotation of a signal causes different elements of a signal to travel in different ways, particularly rotating the plane of polarisation. This can create some problems with reception. A linearly polarised signal can be considered as two contra-rotating circularly polarised signals. The phase velocities of these two signals vary in a magnetic medium such as the ionosphere and as a result the polarisation of the signal changes. The degree of change is dependent upon the state of the ionosphere and it follows the same pattern as that experienced for HF ionospheric communications changing over the course of the day, with the seasons and over the sunspot cycle.

Ionospheric scintillations

Another of the effects introduced by the ionosphere is termed "ionospheric scintillations." These scintillations manifest themselves as a variety of variations of amplitude, phase, and polarisation angle. They can also change the angle of arrival of the signals. These variations change over a period of between one to fifteen seconds, and they can affect signals well into the microwave region.

The variations are caused primarily by the variations in electron density arising in the E region, often as a result of sporadic E but also in the F layer where a spreading effect is the cause. The level of scintillation is dependent upon a number of factors including the location of the earth station and the state of the ionosphere, as a result of the location, the sunspot cycle, the level of geomagnetic activity, latitude, and local time of day.

The scintillations are more intense in equatorial regions, falling with increasing latitude away from the equator but then rising at high latitudes, i.e. in the auroral zone or the region where auroras take place. The effects are also found to decrease with increasing frequency, and generally not noticeable above frequencies of 1 - 2 GHz. As such they are not applicable to many direct broadcast television signals, although they may affect GPS, and some communications satellites.

Tropospheric effects

There are a number of effects that the troposphere introduces including signal bending as a result of refraction, scintillation, and attenuation.

The signal refraction in the troposphere is in the opposite sense to that in the ionosphere. This is because the refractive index in the troposphere is greater than unity, and it is also frequency independent. The signal refraction gives them a greater range than would be expected as a result of the direct geometric line of sight. Tropospheric ducting and extended range effects that are experienced by terrestrial VHF and UHF communications may also be experienced when low angles of elevation are used.

Scintillations induced by the troposphere are often greater than those seen as a result of the ionosphere. They occur as a result of the turbulence in the atmosphere where areas of differing refractive index move around as a result of the wind or convection currents. The degree to which the scintillations occur is dependent upon the angle of inclination, and above angles of around 15 degrees the effect can normally be ignored. At angles between 5 and 10 degrees the changes can often be around 6 dB at frequencies of around 5 GHz.

Doppler shift

Frequency changes as a result of the Doppler shift principle may be in evidence with signals from some satellites. Satellites in Low Earth Orbits move very quickly, and as a result a Doppler frequency shift is apparent in many cases. With the satellite moving towards the earth station the frequency appears higher than nominal, and then as it moves away the apparent frequency falls. The degree of shift is dependent upon a number of factors including the speed of the satellite (more correctly its speed relative to the earth station) and the frequencies in use. Shifts of the order of 10 kHz may be experienced. As most satellites operate in a cross mode configuration, the Doppler shift is not just applicable to the band on which the signal is received, but to the cumulative effect of the uplink and downlink transmissions. In many instances the effects will subtract because of the way the satellite mixing process is configured.

Summary

Although satellites generally operate at frequencies that may be thought to be immune from tropospheric and ionospheric disturbance, these regions still have a significant effect and this needs to be taken into account when designing satellite systems.

http://www.radio-electronics.com/info/propagation/satellite/satellite_propagation.php

Text 3. Thread: Wireless Networking for the IoT Age

Greg Fyke of Silicon Labs looks at Thread, a new IoT protocol that provides native IP addressability, mesh networking & low power consumption.

Today's connected homes use a variety of wireless communication standards to connect equipment such as computers, mobile devices, media players and printers.

Until now, Wi-Fi has been the workhorse of home networking, particularly when it comes to moving digital multimedia content. Homeowners are now taking the next step, seeking further improvements in comfort, quality of life and energy efficiency by connecting devices such as heating controllers, light sensors, switches and security

detectors throughout the home to the Internet. The Internet of Things, IoT, is coming to the connected home.

Like many other IoT devices, the networked sensors and actuators now being proposed for connected home applications are extremely energy sensitive. Typically they must operate for multiple years using a small battery and are subject to tight constraints on computing power, memory and physical size. The choice of wireless communication standard can determine whether all of the performance and connectivity requirements will be met.

Today's established wireless communication technologies impose a number of compromises when used to connect "things" in the home to each other and to the Internet. Although Wi-Fi supports very high throughput for transporting audio, video and data throughout the home, power consumption is usually too high for use by small battery-powered devices. On the other hand, native support for Internet Protocol (IP) allows simple and straightforward connection to the Internet.

In contrast, Bluetooth® Smart has very low power requirements but was conceived for point-to-point communication and bulk data transfers between smartphones and accessories. The latest Bluetooth Core Specification 4.2 provides a basis for native IP connectivity in the future by adding support for IPv6 and 6LoWPAN.

Low-power mesh networking technologies that utilise the IEEE 802.15.4 radio platform are designed for low-bandwidth control and automation applications. ZigBee PRO has been the dominant protocol for more than a decade, and is well suited to connecting hundreds of sensors and actuators throughout the home. ZigBee PRO networks can communicate at data rates up to 250 kbps, and power demand is low enough to allow multi-year battery life. However, ZigBee PRO does not provide native IP support.

A new IP-based mesh networking option is now available: the Thread protocol has been developed to meet the specific needs of connected home applications and overcome the limitations of current wireless networking standards. The specification

was published in April 2015 by the Thread group, which comprises leading global semiconductor, consumer and connected-home brands.

Like ZigBee PRO, Thread utilises the IEEE 802.15.4 radio platform. Unlike ZigBee PRO, however, it provides native IP addressability. In addition, Thread protocol's low power consumption and support for robust, self-healing mesh networking configurations are features that neither Wi-Fi nor Bluetooth Smart can rival.

http://www.radio-electronics.com/articles/wireless-technology/thread-wireless-networking-for-the-iot-160

Text 4. Using IoT to put safety first in the utilities industry

Cresatech, a specialist in continuous and real-time M2M communication technology, has announced it is partnering with Telit, a global enabler of the Internet of Things (IoT) to enable the real-time monitoring of critical electricity distribution infrastructure.

Copper theft has plagued utility providers over recent years, and often goes unnoticed until things go wrong. For example, until now, those operating in the electricity sector would have been blind to copper theft until a fault occurred, leaving both its employees and the wider public exposed to the potentially deadly combination of live electricity and unearthed equipment. By using Cresatech's CuTS monitoring solution utility providers know immediately where safety has been compromised and take the important corrective action, restoring normal service and mitigating risk.

Powered by Telit's IoT modules and IoT Portal, Cresatech's CuTS solution uses edge computing connectivity to provide a real-time status dashboard and generate alerts when substation earthing is damaged or stolen. Using secure wireless communication, Cresatech's solution integrates seamlessly into Telit's IoT Portal bringing its monitoring sensors online and providing utility service providers up-to-the-minute detailed information on the status of their infrastructure. This helps utility providers maintain complete control of their infrastructure, minimizing outages, improving utility performance and customer satisfaction.

Additionally, in a world increasingly under threat of cyber-attack, it is essential for utility providers to know that the high levels of security protect any element of online connectivity. Through its work with large corporations, including manufacturing plants where digital security is critical, Telit has a proven track record that ensures a secure platform. This allows utility providers to use Cresatech's solution with complete confidence over cyber security.

Cresatech CEO Simon Nash commented, "Our solution hinges on being able to provide our customers with secure constant connectivity to enable real-time monitoring. Working in the utilities industry we are working with some of the world's largest and most essential companies and by partnering with Telit, we are able to ensure a quality, secure product that meets the needs of our customers."

Sammy Yahiaoui, Telit Vice President of EMEA IoT Services Sales commented, "Cresatech is able to monitor, collect and communicate real-time data securely from exposed service sites and infrastructures in complex operational environments with Telit's end-to-end IoT solutions. The companies together are helping customers to achieve operational, process and safety requirements that reduce cost and mitigate hazardous risks."

http://www.radio-electronics.com/news/wireless-technology/using-iot-to-put-safety-first-8217

Text 5. Primary reference time clock protects against GNSS vulnerabilities

Microsemi has announced the availability of its TimeSource Enhanced Primary Reference Time Clock (TimeSource Enhanced PRTC), a new system enabling telecommunications and mobile operators to meet the new G.8272.1 recommendation from the International Telecommunication Union (ITU), while also protecting against serious threats associated with global navigation satellite system (GNSS) vulnerabilities.

The TimeSource Enhanced PRTC "generates time" by producing its own independent time scale aligned with GNSS, while its phase, time and frequency signal outputs remain autonomous. This provides customers within the communications,

power, public safety, data center and government network markets with a secure infrastructure, reducing dependency on GNSS and enabling network operators to retake control of the timing source used for network synchronization. The new system is also designed to meet the stringent new ITU-T Recommendation G.8272.1, which requires accuracy to within 30 nanoseconds (ns) or better when verified against a time standard such as UTC.

"Worldwide telecommunications, power utilities and other infrastructure customers are in critical need of protection against GNSS vulnerability, and Microsemi's new TimeSource Enhanced PRTC provides a powerful, high performance solution to address this need," said Randy Brudzinski, vice president and business unit manager of Microsemi's Frequency and Time division. "In addition, maintaining less than 30 ns performance is important to mobile operators who require a high level of accuracy to support LTE/4G and the upcoming deployment of 5G."

Massive deployment of GNSS as a timing source for synchronizing telecommunications networks (both wired and wireless) has created security risks to a point where governments, major telecommunications/mobile operators and enterprises are now urgently looking to protect their networks against both regional GNSS issues as well as the potential of a global GNSS outage. Microsemi's TimeSource Enhanced PRTC works with the company's cesium clocks to ensure time is generated in an autonomous manner. Specifically, the TimeSource Enhanced PRTC's "source of time" aligns accurately with GNSS time without being dependent upon it—avoiding any vulnerability to threats caused by jamming and spoofing.

According to Research and Markets' report from market research firm Markets and Markets titled, "Anti-Jamming Market for GPS by Technique (Nulling System, Beam Steering System, Civilian System), Receiver Type (Military & Government Grade, Commercial Transportation Grade), Application, End User, and Geography - Global Forecast to 2022," the anti-jamming market for GPS is expected to reach $4.8 billion and more than 309,000 units by 2022, at a compound annual growth rate (CAGR) of 7 percent and 10 percent, respectively, between 2016-2022. Demand for secured

weapons guided systems and increasing vulnerability of GPS signals due to development of low-cost GPS jammers are the major growth drivers of the market.

http://www.radio-electronics.com/news/satellite-technology/primary-reference-time-clock-protects-against-7725

Text 6. Video sound collaboration system launched for huddle rooms

As businesses and organizations continue to use remote communications technology to bridge distances and share ideas, there has been a proliferation of huddle room and small meeting rooms. These new spaces demand technologies that are more convenient and enable a seamless collaboration experience so users can easily come together to exchange information, share ideas, and collaborate at any time. Yamaha has announced the CS-700, an all-in-one collaboration solution specifically designed to support these environments. The CS-700 combines clear audio with high-quality video to fulfill huddle room requirements and collaboration capabilities in one simple, wall-mounted system.

"The Yamaha CS-700 is the first of many solutions that combine the market expertise of Revolabs with the product expertise of Yamaha to deliver excellent audio, video, and collaboration capabilities," said Yoshi Tsugawa, director, Yamaha Commercial Audio Department. "The CS-700 is the first product in this initiative to demonstrate Yamaha's commitment to the business collaboration market and improving the meeting experience at every level."

Yamaha entered the conferencing market in 2006, offering microphone and speaker systems, including the YVC-1000 USB and Bluetooth conferencing phone. In 2014, the company acquired Revolabs, a provider of audio solutions for unified communications and enterprise collaboration. Together, these companies deliver solutions that ensure participants in remote conferences can hear and be heard clearly in every meeting environment.

The Yamaha CS-700 is the first solution of its kind to bring together comprehensive audio, video, and collaboration capabilities in a wall-mounted system.

Combining Revolabs' expertise in microphone technology, Yamaha's loudspeaker engineering, and new high-quality video and screen sharing capabilities, the CS-700 provides an affordable, simple-to-install, high-fidelity system for successful teamwork from a single USB connection.

For clear, stress-free audio, the CS-700 boasts a beamforming microphone array, ensuring that every word spoken is perfectly captured and delivered to the far end. In addition, four speaker elements provide the highest degree of audio coverage for all the participants in the room. Through the integrated USB port, the CS-700 is ready to connect to the organization's chosen unified communications platform, such as Microsoft Skype for Business, Cisco Spark, GoToConference, Google Chromebox for Meetings, Vidyo, WebEx, Zoom, BlueJeans, and many others. The unit's special wide-angle video camera captures all meeting participants in the room, even those close to the camera. The optical solution ensures a high "pixel-per-face" resolution necessary for participants to recognize nuanced facial expressions that are vital to effective meetings.

Over the same USB connection to their laptop or tablet, users can seamlessly and intuitively join a meeting. This plug-and-play approach allows users to quickly get started without wrestling with disparate video, audio, and collaboration components in the room, thus eliminating complex steps from the process that can waste valuable meeting time or require the assistance of on-call IT staff. In addition, the CS-700's integrated network management system allows IT staff to remotely manage each unit from one location, increasing service response and efficiency.

http://www.radio-electronics.com/news/telecoms-networks/video-sound-collaboration-system-launched-for-8222

Text 7. The history of Wi-Fi

If you are under 21, you probably cannot conceive of an unconnected world. For many, mobile devices are literally an extension of their arm. How did we get to this world – 7.1 billion people and 7.2 billion mobile devices, where communication, pop

culture, business, news, and personal social lives are completely intertwined – and completely ubiquitous? The history of Wi-Fi is really the history of modern communication. Following are some, although clearly not all, of the highlights that led us to modern Wi-Fi.

1896. World population is ~1.6 billion people. AT&T has about 500,000 telephones in the Bell System. Guglielmo Marconi develops the first wireless telegraph system, establishing the foundation for all future radio technology.

1947. World population is now ~2.6 billion. Most homes do not yet have television, but the first ever mass audience of ~ 3.9 million people crowd into taverns to watch the first televised World Series. The merger of computers and communications is born with the invention of the transistor. Bell Labs scientists John Bardeen, Walter Brattain and William Shockley win the 1956 Nobel Prize for this epic invention.

1962. 9 out of 10 US households now have a TV – 52 million sets. Telstar, The first communication satellite, is launched into orbit.

1969. Over 125 million people tune in to watch the Apollo 11 Moon Landing – mostly in black and white. Arpanet, the first workable prototype of the Internet, is launched. It uses packet switching to allow multiple computers to communicate on a single network.

1985: Over 340,000 US citizens carry cell phones. The FCC releases 3 "garbage bands" for use without a government license: 900MHz, 2.4GHz and 5.8GHz, radiofrequencies then allocated to non-communication purposes like microwave ovens. The IEEE ((Institute of Electrical and Electronics Engineers) and WECA, (Wireless Ethernet Compatibility Alliance) form soon thereafter. A set of media access control (MAC) and physical layer (PHY) specifications for implementing wireless local area network (WLAN) called 802.11 (Max 2 Mbps) is developed..

1990. 12.5 million cell phone subscribers worldwide. Computer scientist Tim Berners-Lee, with the help of Robert Cailliau, completes the first successful communication between a computer and a server, a critical step in the development of the World Wide Web.

1997 – 2000. World population has reached ~6 billion people. 140.2 million personal computers are sold worldwide; more than half of US households now have a PC. A committee, made up of engineers from NCR Corporation, Bell Labs, and IEEE agree on an industrywide wireless standard; a data transfer rate of two megabits per second, using either of two spread spectrum technologies, frequency hopping or direct sequence transmission. 802.11a and 802.11b, (Max 11 Mbps) are released, and a big explosion in wireless capabilities occurs. In 1999, "IEEE 802.11b Direct Sequence" is renamed "Wi-Fi" by cobrand-consulting firm Interbrand Corporation. Lucent develops a Wi-Fi adapter for under $100, and Apple introduces Wi-Fi on the iBook, under the brand name AirPort.

2003 – 2007. The number of mobile-phone users in the U.S. surpasses the number of conventional land-based phone lines. Steve Jobs unveils the very first iPhone, a Wi-Fi dependent computer that happened to make phone calls. 802.11g 802.11e and 802.11n are released (with 802.11n topping out at Max 600 Mbps).

2009 – 2015: Starbucks announces free Wi-Fi at all their shops. Mobile digital media time in the US is now significantly higher at 51% compared to desktop (42%). Social media plays a major role in The Arab Spring. Barrack Obama@POTUS sends his first Tweet. And the number of mobile devices now outnumbers humans. 802.11v, 802.11k, 802.11u, 802.11acI, and 802.11acII are all released. (With 802.11acII topping out at Max 6.93 Gbps).

So here we are. From the invention of radio frequencies, to a Wi-Fi protocol speed now 3548 times faster than when it was first invented. The history of Wi-Fi really is the history of all modern communication.

http://www.ucopia.com/news/history-of-wi-fi

Text 8. The evolution of Wi-Fi

Since its inception, Wi-Fi has played an integral role in keeping us connected at home and in public. We have come to expect a standard degree of connectivity wherever we go, and regularly rely on Wi-Fi to maintain our productivity, our organization, our

health, and even our protection. But how many of us know the full history behind Wi-Fi technology? How exactly does it work? And just how far it has come in 20 years? Here we have explored the evolution of Wi-Fi, from where it began, what it has helped us achieve, and what future it promises us as we become increasingly interconnected.

What is Wi-Fi, and How Does it Work?

At a base level, Wi-Fi is a way of getting broadband internet to a device using wireless transmitters and radio signals. Once a transmitter receives data from the internet, it converts the data into a radio signal that can be received and read by Wi-Fi enabled devices. Information is then exchanged between the transmitter and the device.

Where it All Began

Wi-Fi was first released for consumers in 1997, when a committee called 802.11 was created. This lead to the creation of IEEE802.11, which refers to a set of standards that define communication for wireless local area networks (WLANs). Following this, a basic specification for Wi-Fi was established, allowing two megabytes per second of data transfer wirelessly between devices. This sparked a development in prototype equipment (routers) to comply with IEEE802.11, and in 1999, Wi-Fi was introduced for home use.

Wi-Fi Frequencies

Wi-Fi uses electromagnetic waves to communicate data that run at two main frequencies: 2.4 GHz (802.11b) and 5 GHz (802.11a). For many years, 2.4 GHz was a popular choice for Wi-Fi users, as it worked with most mainstream devices and was less expensive than 11a.

Getting Stronger

In 2003, faster speeds and distance coverage of the earlier Wi-Fi versions combined to make the 802.11g standard. Routers were getting better too, with higher power and further coverage than ever before. Wi-Fi was beginning to catch up – competing with the speed of the fastest wired connections.

Overcrowded

The 2.4 Ghz extended range meant that an increasing number of devices (from

baby monitors to Bluetooth) were using the same frequency, causing it to become overcrowded and slower. Consequently, 5 GHz became the more attractive option.

Wi-Fi Today and the Internet of Things

The use of Wi-Fi today is summed up nicely by Rethink Wireless: "Wi-Fi performance continues to improve and it's one of the most ubiquitous wireless communications technologies in use today. It is easy to install, simple to use and economical too. Wi-Fi Access Points are now set up at home and in public hotspots, giving convenient internet access to everything from laptops to smartphones. Encryption technologies make Wi-Fi secure, keeping out unwanted intruders from these wireless communications."

However, Wi-Fi is more about simply getting online to check email or browse social feeds. It has also enabled a mind-blowing number of consumer electronics and computing devices to become interconnected and exchange information – a phenomenon known as Internet of Things. It's clear that WiFi is no longer a one-way street – it has become an essential part of our personal and professional day-to-day, and is constantly improving our efficiency, our communication, and is persistently encourages the technology industry to push the boundaries of what's possible.

All in all, the capabilities of Wi-Fi are endless, and with the way things are going, we are incredibly excited to see what the future holds.

http://purple.ai/history-wifi/

Text 9. Nanoengineered bioinks for 3D printing

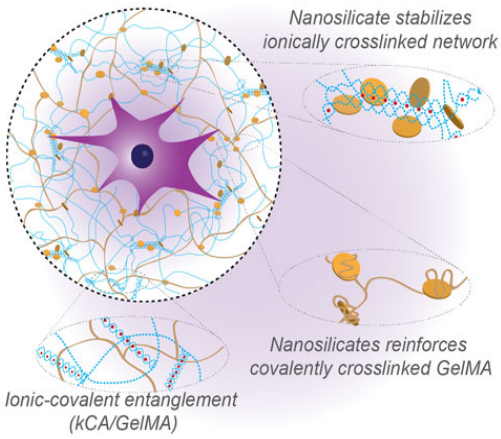
Imagine being able to print out healthy tissue with just a sample of a patient's own cells. While printed replacement human body parts might seem like science fiction, the use of 3D printing technologies for medical applications is a relatively new but rapidly expanding research field, although still quite a way from clinical application for treating patients.

Currently, two of the biggest problems facing three-dimensional (3D) bioprinting are that bioinks – a jelly-like substance consisting mostly of water – don't print with anywhere near the performance of other 3D printed materials; and they aren't strong enough at cell-friendly concentrations. In other words, currently available bioinks cannot 3D print self-sustaining anatomic-size structures containing live cells.

Another major challenge that bioinks present is their complexity. It's clear that simple polymer solutions that were initially tried are not meeting all of the requirements of bioinks, so more and more researchers are looking into state-of-the-art material science techniques to give bioinks a boost. It looks like 3D bioprinting is developing into a very multidisciplinary field that is going to require scientists to become knowledgeable outside their main field, including biology as well as materials science and chemistry, in order to develop advances.

However, not all tissue engineering labs have the necessary chemistry and materials science expertise and support to replicate the more complex designs that are coming out, which is part of the reason why researchers at Texas A&M University stuck to inexpensive and widely available ingredients to create a novel bioink. To overcome the limitations of existing bioinks, they report the development of a highly printable bioink for fabricating large scale, cell-laden, bioactive scaffolds.

"We have achieved these improvements through a novel bioink strengthening strategy that combines nanocomposite reinforcement with ionic-covalent entanglement (ICE) to create a bioactive nanoengineered ionic-covalent entanglement (NICE) bioink with excellent printability, mechanical properties, and shape fidelity," Akhilesh K. Gaharwar, an Assistant Professor at Texas A&M University, tells Nanowerk.



(Image: Inspired Nanomaterials and Tissue Engineering (iNanoTE) Lab, Texas A&M University)

The NICE bioinks use nanosilicates to reinforce an ionic-covalent entanglement hydrogel made from GelMA and κCA, creating a dually reinforced hydrogel network. These interactions allow the NICE bioink to behave as a solid at low shear stresses and improve shear thinning characteristics during bioprinting. After cross-linking, ICE and nanosilicate reinforcement synergistically improve mechanical strength. The core finding of this work is that it is possible to combine two very different hydrogel reinforcement techniques to obtain synergistic reinforcement and improved printability without sacrificing the cell-friendly nature of the hydrogel.

While nanocomposite reinforcements and dual crosslinked polymer blends (ICEs) have both been investigated separately for improving mechanical properties of hydrogels, they have never been applied simultaneously to a bioink for tissue engineering or bioprinting applications.

And it turns out that the combination (NICE) is even more effective than the sum of its individual parts. From a mechanical perspective, this is notable because conventional bioinks had to increase crosslinking density to gain mechanical strength, to a point that that was damaging to cell in the ink.

In contrast, the unique characteristics of the NICE bioink is its ability to 3D print larger, taller tissue structures that are tough and resilient, while keeping the embedded cells alive during the printing process. The high structural fidelity and mechanical

stiffness of the bioprinted structures using NICE bioinks could be used as custom implants. In addition, 3D bioprinted structures from NICE bioink can be used to understand cancer progression as well as drug testing.

Source: Michael Berger –https://www.nanowerk.com/spotlight/spotid=49747.php

Text 10.
Mind the gap - nanotechnology robotics vision versus lab reality

Science fiction style robots like Star Wars' R2-D2 or the NS-5 model in I, Robot firmly belong into the realm of Hollywood – and so do "nanobots" à la Michael Crichton's Prey. Staying with both feet firmly on scientific ground, robotics can be defined as the theory and application of robots, a completely self-contained electronic, electric, or mechanical device, to such activities as manufacturing. Scale that robot down to a few billionth of a meter and you are talking nanotechnology robotics; nanorobotics in short.

The field of nanorobotics brings together several disciplines, including nanofabrication processes used for producing nanoscale robots, nanoactuators, nanosensors, and physical modeling at nanoscales. Nanorobotic manipulation technologies, including the assembly of nanometer-sized parts, the manipulation of biological cells or molecules, and the types of robots used to perform these tasks also form a component of nanorobotics.

Nanorobotics might one day even lead to the holy grail of nanotechnology where automated and self-contained molecular assemblers not only are capable of building complex molecules but build copies of themselves – "self-replication" – or even complete everyday products.

Whether this will ever happen is hotly debated – to understand where both sides stand, read the famous 2003 debate where Drexler and Smalley make the case for and against molecular assemblers. Today's nanorobotics research deals with more mundane issues such as how to build nanoscale motors and simple nanomanipulators.

Nanotechnology robots are quintessential NEMS (nanoelectromechanical systems) and raise all the important issues that must be addressed in NEMS design: sensing, actuation, control, communications, power, and interfacing across spatial scales and between organic and inorganic materials. Due to their size, comparable to biological cells, nanorobots have a vast array of potential applications in fields such as environmental monitoring or medicine.

"Ultimately, one of the most important applications of nanorobotic manipulation will be nanorobotic assembly" Bradley J. Nelson explains to Nanowerk. "However, it appears that until assemblers capable of replication can be built, the parallelism of chemical synthesis and self-assembly are necessary when starting from atoms."

Actuation at the nanoscale

The positioning of nanorobots and nanorobotic manipulators depends largely on nanoactuators, i.e. nanoscale devices that create mechanical motion by converting various forms of energy to rotating or linear mechanical energy.

"During the design of an actuator, the tradeoffs among range of motion, force, speed (actuation frequency), power consumption, control accuracy, system reliability, robustness, load capacity, etc. must be taken into consideration" says Nelson.

While nano-sized actuators for nanorobots are still under exploration and relatively far from implementation, microelectromechanical system (MEMS)-based efforts are focused on shrinking their sizes. The various nanoactuation principles include electrostatics, electromagnetics and piezoelectrics.

Source: Michael Berger https://www.nanowerk.com/spotlight/spotid=1730.php

Text 11.

Materials, Microscopy and Modeling Combine to Improve Jet Engine Perfomance.

Collaboration among materials scientists, electron microscopy experts and aerospace industry leaders may lead to major improvements in jet turbine engine

performance. The relentless drive for energy efficiency in power generation and propulsion places immense value on the development of high-performance materials. Turbine engine efficiency and reduction in carbon emissions are directly related to engine operating temperature. With increasing temperatures, materials start to change in shape or size—a process known as creep—which eventually limits the materials' performance. A recent article in *Nature Communications* shares results of a study titled "Phase transformation strengthening of high-temperature superalloys" led by Ohio State University materials science and engineering professor Michael Mills. "Increased performance in aircraft engines and land-based power generators require the development of a new generation of high-temperature structural materials that are resistant to creep," said Mills. This study serves to address a deficit in quantitative, comprehensive understanding of deformation mechanisms for various alloy compositions in high-temperature, high-stress conditions that are relevant to advanced engine designs. The quantitative analysis combined atomic-resolution imaging with density functional theory (DFT) calculations, through collaborations with Robert Williams at Ohio State's Center for Electron Microscopy and Analysis (CEMAS) and Anna Carlsson of FEI/Thermo Fisher Scientific, among others. This coupled approach resulted in the discovery of a high-temperature strengthening mechanism, which the research team refers to as phase transformation strengthening. "Through advanced imaging and DFT calculations we found that increasing the concentrations of the elements titanium, tantalum and niobium in superalloys inhibits the formation of high temperature deformation twins," Mills said, "thereby significantly improving the alloys' high temperature capabilities." Research such as this perfectly illustrates the power of CEMAS to help drive discovery in new materials and processes," said CEMAS Director David McComb. The study also benefitted from industry insight provided by GE Aviation lead materials engineer Andrew Wessman. According to Mills, this mechanism may be further manipulated through alloying and processing to further improve the high-temperature properties of next-generation superalloys for critical structural applications. In addition to jet turbine engines, phase transformation

strengthening may lead to performance enhancements in turbomachinery for transportation and power generation. For more advancements in aviation, find out how a novel airplane wing design increases efficiency and simplifies manufacturing.

Source: The Ohio State University

Text 12.

Tiny Squeeze Boosts Performance of Platinum Catalysts

A nano-size squeeze can significantly boost the performance of platinum catalysts that help generate energy in fuel cells, according to a new study by Stanford researchers.

The team bonded a platinum catalyst to a thin material that expands and contracts as electrons move in and out, and found that squeezing the platinum a fraction of a nanometer nearly doubled its catalytic activity. The findings are published in the journal *Science*.

"In this study, we present a new way to fine-tune metal catalysts at the atomic scale," said lead author Haotian Wang, a former graduate student at Stanford now at Harvard University. "We found that ordinary battery materials can be used to control the activity of platinum and possibly for many other metal catalysts."The new technique can be applied to a wide range of clean technologies, Wang said, including fuel cells that use platinum catalysts to generate energy, and platinum electrolyzers that split water into oxygen and hydrogen fuel. "Our tuning technique could make fuel cells more energy efficient and increase their power output," said co-author Yi Cui, a professor of materials science and engineering at Stanford. "It could also improve the hydrogen-generation efficiency of water splitters and enhance the production of other fuels and chemicals."

An Experimental Electrode

The study focused on lithium cobalt oxide, a material widely used in batteries for cellphones and other electronic devices. The researchers stacked several layers of lithium cobalt oxide together to form a battery-like electrode.

"Applying electricity removes lithium ions from the electrode, causing it to expand by 0.01 nanometer," Cui said. "When lithium is reinserted during the discharge phase, the electrode contracts to its original size."

For the experiment, the Stanford team added several layers of platinum to the lithium cobalt oxide electrode.

"Because platinum is bonded to the edge, it expands with the rest of the electrode when electricity is added and contracts during discharge," Cui said.

Platinum Performance

Separating the platinum layers a distance of 0.01 nanometer, or 5 percent, had a significant impact on performance, Wang said.

"We found that compression makes platinum much more active," he said. "We observed a 90 percent enhancement in the ability of platinum to reduce oxygen in water. This could improve the efficiency of hydrogen fuel cells."

Stretching the electrode by 5 percent had the opposite effect, suppressing oxygen production by 40 percent, Wang said.

"This is a dream experiment for a theorist," said study co-author Jens Norskov, a professor of chemical engineering at Stanford's SUNCAT Center for Interface Science and Catalysis. "We predicted theoretically some years ago that straining a catalyst can be used to control its performance, and here is the experiment to show that our theory works well."

"Our technology offers a very powerful way to controllably tune catalytic behavior," Cui added. "Now, mediocre catalysts can become good, and good catalysts can become excellent."

Source: Stanford University

Appendix

1. Как составить аннотацию к тексту на русском языке

При написании аннотации используйте следующие клише:

Статья (текст) посвящена проблеме/вопросу … В начале статьи

- речь идет о …
- дается определение …
- обосновывается значимость …
- привлекается внимание …

Далее

- описывается …
- рассказывается…
- рассматривается …
- излагается …

В частности

- отмечается, например, …
- подробно излагается …
- описывается схема …
- указывается …
- доказывается мысль …

Наконец

- рассказывается…

В заключение

- приводятся примеры

Подытоживая сказанное, следует отметить …

Как мне кажется, статья может представлять интерес для …

Думается, статья может оказаться полезной для …

2. Как составить аннотацию к тексту на английском языке

Для составления аннотации используйте следующие клише:

The text/article under review … (gives us a sort of information about …).

The article deals with the problem …

The subject of the text is …

At the beginning (of the text) the author describes … (dwells on …; explains…; touches upon …; analyses …; comments …; characterizes …)

The article begins with the description of …, a review of …, the analyses of … The article opens with …

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

To finish with, the author describes …

At the end of the article the author draws the conclusion that …; the author sums it all up (by saying …)

In conclusion the author …

3. Как подготовить презентацию

Phrases which help you to make a presentation:

1. Introduction

• -Good morning, everybody! (ladies and gentlemen).

• -Let me introduce myself. My name is.. ./I am a first year law student.

• -The topic of my presentation is.. ./Today I would like to tell you about…

• -I have chosen this topic because…, / The purpose of my presentation is to inform/ to persuade…

• -The form of my presentation is .. ./The body of my presentation consists of…

• -It will take only 5-7minutes of your time.

2. Body

• -First..

• -I have divided my presentation into 2-3 parts.

• -Then…

-After that I'd like to move on to… /-Next I'd like to move on to… /-Finally I'd like to move on to…

3. Conclusion

• -Let us summarize briefly what we have looked at.

• -Let us briefly summarize the main issues.

• -In conclusion I want to say.

• -That is the end of my presentation.

• -Thank you for your listening/attention.

4. Inviting questions

• -You are welcome with your questions.

• -I am ready to answer any of your questions.

• -Could you repeat your question?

• -I am sorry, but I didn't follow your question.

• -If there are no more questions thank you again for your attention.

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