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«Белорусский государственный университет
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Кафедра иностранных языков №1

МЕТОДИЧЕСКОЕ ПОСОБИЕ ПО РАЗВИТИЮ НАВЫКОВ ЧТЕНИЯ НА АНГЛИЙСКОМ ЯЗЫКЕ ДЛЯ СТУДЕНТОВ 1 КУРСА ФРЭ

READ AND SPEAK FOR FULL TIME STUDENTS OF THE RADIOENGINEERING AND ELECTRONICS FACULTY

Минск БГУИР 2010

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Включает девять разделов и приложение. Каждый раздел содержит краткий тематический словарь, тексты и задания к ним. В приложении даны тексты для дополнительного чтения.

Единый комплекс упражнений и заданий ориентирован на развитие у студентов ФРЭ навыков и умений чтения литературы и специальных оригинальных текстов. Авторами методического пособия реализовано требование профессионально-ориентированного обучения.

Предназначено для работы в аудитории под руководством преподавателя и для самостоятельной работы.

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CONTENTS

UNIT I

QUANTUM SYSTEMS

Word List

arbitrary	/ 'Q:bItrqrI /	произвольный, случайный
behaviour	/ bI'heIvjq /	образ действий; поведение
bond	/ bPnd /	связывать
cell	/ sel /	клетка, ячейка
digital	/ 'dIdZIt(q)l /	цифровой
discovery	/ dIs'kAvqrI /	открытие
electric current	/ I'lektrIk 'kArqnt /	электрический ток
enable	/ I'neIbl /	давать возможность, право (что-либо сделать)
entity	/ 'entItI /	нечто реально существующее, объект
equal	/ 'i:kwql /	равный, одинаковый
erase	/ I'reIz /	стирать, подчищать
indispensable	/ "IndIs'pensqbl /	важный, необходимый
infinitesimal	/ "InfInI'tesImql /	бесконечно малая величина; бесконечно малый
involve	// In'vPlv /	привлекать, вовлекать
layer	/ 'leIq /	слой, пласт
matter	/ 'mxtq /	вещество; иметь значение; значить
measure	/ 'meZq /	мера; единица измерения; измерять, мерить
particle	/ 'pQ:tIkl /	частица; крупица
penetrate	/ 'penItreIt /	проникать внутрь; проходить сквозь, пронизывать
perform	/ pq'fO:m /	исполнять, выполнять
principle	/ 'prInsqpl /	правило; закон; принцип
research	/ rI'sq:tS /	(научное) исследование; изучение
retrieve	/ rI'tri:v /	отыскивать (информацию), извлекать
significant	/ sIg'nIfIkqnt /	значительный, важный, существенный
superposition	/ 'sju:pqpq'zISqn /	наложение, совмещение, суперпозиция
vital	/ 'vaItl /	(жизненно) важный, насущный, существенный; необходимый

Part A

1. Translate the following international words.

Principle, ionic, covalent, technology, laser, microchip, diode, oxide, electron, proton, neutron, photon, mechanics, microscope, atomic, subatomic, hypothesis, clone, transistor, system.

2. Define the following words as parts of speech and give the initial words of the following derivatives.

Discovery, atomic, foundation, studied, fundamental, statistical, understanding, favorable, calculation, superposition, significant, provision, penetration, infinitesimal, behaviour.

3. Form adverbs and translate the words.

Approximate, energetical, explicit, mathematical, strong, satisfactory, active.

4. Arrange the words of the two groups in pairs with similar meaning:

1) arbitrary	a) important
2) vital	b) urgent
3) perform	c) rule
4) principle	d) conduct
5) bond	e) organism
6) discovery	f) accidental
7) entity	g) make possible
8) enable	h) look for
9) significant	i) finding
10) seek	j) connect

5. Match the words with their definitions.

1) behaviour	a) absolutely necessary; essential
2) indispensable	b) a flow of electric charge through a conductor
3) cell	c) identical in size, quantity, degree, etc.
4) electric current	d) to remove a recording from magnetic tape
5) digital	e) an extremely small piece of matter
6) erase	f) to recover or make newly available (stored information) from a computer system
7) infinitesimal	g) the basic structural and functional unit of living organisms
8) involve	h) substance that occupies space and has mass
9) matter	i) systematic investigation to establish facts or principles or to collect information on a subject
10) particle	j) to include or contain as a necessary part
11) research	k) representing data as a series of numerical values
12) retrieve	l) the action, reaction, or functioning of a system, under normal or specified circumstances
13) equal	m) infinitely or immeasurably small

6. Fill in the gaps with one of the following words: **indispensable, performed, penetrate, superposition, cells, researchers, enables.**

1. Flash memory chips found in USB drives also use quantum tunneling to erase their memory … .
2. Most of the calculations ... in computational chemistry rely on quantum mechanics.
3. … are currently seeking robust methods of directly manipulating quantum states.
4. Quantum tunneling is vital, as otherwise the electrons in the electric current could not … the potential barrier.
5. The state may be in a … of basis values.
6. The study of semiconductors led to the invention of the diode and the transistor, which are … for modern electronics.
7. The ability to manipulate quantum information … us to perform tasks that would be unachievable in a classical context.

7. Read the text. Choose the sentences covering the main idea of the text.

Quantum Mechanics

The discovery that waves have discrete energy packets (called quanta[1]) that behave in a manner similar to particles led to the branch of physics that deals with atomic and subatomic systems which we today call quantum mechanics. The foundations of quantum mechanics were established during the first half of the twentieth century by Werner Heisenberg, Max Planck, Louis de Broglie, Albert Einstein, Niels Bohr, Erwin Schrödinger, Max Born, John von Neumann, Paul Dirac, Wolfgang Pauli, David Hilbert, and others. Some fundamental aspects of the theory are still actively studied.

Quantum mechanics has had enormous success in explaining many of the features of our world. The individual behaviour of the subatomic particles that make up all forms of matter – electrons, protons, neutrons, photons and others – can often only be satisfactorily described using quantum mechanics. Quantum mechanics has strongly influenced string theory, a candidate for a theory of everything and the multiverse hypothesis. It is also related to statistical mechanics.

Quantum mechanics is important for understanding how individual atoms combine covalently to form chemicals or molecules. The application of quantum mechanics to chemistry is known as quantum chemistry. Relativistic quantum mechanics can in principle mathematically describe most of chemistry. Quantum mechanics can provide quantitative insight into ionic and covalent bonding processes by explicitly showing which molecules are energetically favorable to which others, and by approximately how much. Most of the calculations performed in computational chemistry rely on quantum mechanics.

Much of modern technology operates at a scale where quantum effects are significant. Examples include the laser, the transistor (and thus the microchip), the electron microscope, and magnetic resonance imaging. The study of semiconductors led to the invention of the diode and the transistor, which are indispensable for modern electronics.

Researchers are currently seeking robust methods of directly manipulating quantum states. Efforts are being made to develop quantum cryptography, which will allow guaranteed secure transmission of information. A more distant goal is the development of quantum computers, which are expected to perform certain computational tasks exponentially faster than classical computers. Another active research topic is quantum teleportation, which deals with techniques to transmit quantum states over arbitrary distances.

In many devices, even the simple light switch, quantum tunneling[2] is vital, as otherwise the electrons in the electric current could not penetrate the potential barrier made up, in the case of the light switch, of a layer of oxide. Flash memory chips found in USB[3] drives also use quantum tunneling to erase their memory cells.

Notes:
[1]quantum (pl. quanta) – доля, часть; квант; фотон;
[2]tunneling – туннельный эффект; туннельный переход;
[3]USB drive (another name for flash drive) – флэш-память.

8. Mark the following statements as true or false in relation to the text. If a statement is false, change it to make it true.

1. Some basic questions of quantum mechanics are still being actively studied.
2. Much of modern technology operates at a scale where quantum effects are unimportant.
3. At present, scientists are searching for robust methods of indirectly manipulating quantum states.
4. Another active research problem is quantum teleportation, which is related to techniques to transmit quantum states over arbitrary distances.
5. A more distant aim is the elaboration of quantum computers.

9. Match parts A and B to complete the sentences.

A	B
1. Efforts are being made to develop quantum cryptography …	a) can often only be satisfactorily described using quantum mechanics.
2. Much of modern technology operates at a scale …	b) how individual atoms combine covalently to form chemicals or molecules.
3. Quantum mechanics is important for understanding …	d) is known as quantum chemistry.
4. The application of quantum mechanics to chemistry …	c) where quantum effects are significant.
5. The individual behaviour of the subatomic particles that make up all forms of matter …	e) which will allow guaranteed secure transmission of information.

10. Using the information from the text speak about the importance of quantum mechanics.

11. Make an outline of the text.

12. Make a short summary of the text in written form using your outline.

Part B

13. Read the text and write out key words and phrases revealing the contents of the text.

14. Divide the text into logical parts and entitle each part.

15. Find one or two sentences which can be omitted as inessential in each logical part.

Quantum Information

In quantum mechanics, quantum information is physical information that is held in the "state" of a quantum system. The most popular unit of quantum information is the qubit, a two-level quantum system. However, unlike classical digital states (which are discrete), a two-state quantum system can actually be in a superposition of the two states at any given time.

Quantum information differs from classical information in several respects, among which we note the following:

It cannot be read without the state becoming the measured value.

An arbitrary state cannot be cloned.

The state may be in a superposition of basis values.

However, despite this, the amount of information that can be retrieved in a single qubit is equal to one bit. It is in the processing of information (quantum computation) that a difference occurs.

The ability to manipulate quantum information enables us to perform tasks that would be unachievable in a classical context, such as unconditionally secure transmission of information. Quantum information processing is the most general field that is concerned with quantum information. There are certain tasks which classical computers cannot perform "efficiently" (that is, in polynomial time) according to any known algorithm. However, a quantum computer can compute the answer to some of these problems in polynomial time; one well-known example of this is Shor's factoring algorithm. Other algorithms can speed up a task less dramatically – for example, Grover's search algorithm which gives a quadratic speed-up over the best possible classical algorithm.

16. Make a questionnaire to the text and interview your partner on the problems raised in the text.

17. Sum up the text using the key words, word combinations and the topical sentences.

18. Express your attitude to the facts given in the text. You may use the following phrases:

– It is full of interesting information…
– I find the text rather / very cognitive…
– I've learnt a lot …
– I don't agree with …

19. Say which facts presented in the text you've already been familiar with (*already known*).

20. Give your point of view on the possibility of using the information presented in the text in your future profession.

Part C

21. Look through the following text, define the information presented in it and entitle the text.

22. Scan the following text and say what problem is described in it.

Text C

In physics, a quantum (plural: quanta) is the minimum unit of any physical entity involved in an interaction. An example of an entity that is quantized is the energy transfer of elementary particles of matter (called fermions) and of photons and other bosons. The word comes from the Latin "quantus", for "how much". Behind this, one finds the fundamental notion that a physical property may be "quantized", referred to as "quantization". This means that the magnitude can take on only certain discrete numerical values, rather than any value, at least within a range. There is a related term of quantum number.

A photon, for example, is a single quantum of light, and may thus be referred to as a "light quantum". The energy of an electron bound to an atom (at rest) is said to be quantized, which results in the stability of atoms, and of matter in general.

As incorporated into the theory of quantum mechanics, this is regarded by physicists as part of the fundamental framework for understanding and describing nature at the infinitesimal level, for the very practical reason that it works. It is "in the nature of things", not a more or less arbitrary human preference.

23. Say where the presented information can be used.

24. Speak on one of the following points to your partner:

a) the minimum unit of any physical entity;
b) a single quantum of light.

UNIT II
NANOTECHNOLOGIES AND NANOMATERIALS IN ELECTRONICS

Word List

assume	/ q'sjHm /	допускать, предполагать
challenge	/ 'CxlInG /	сложная задача, проблема; ставить под сомнение, оспаривать; требовать (усилий)
deliver	/ dI'lIvq /	поставлять; передавать
dispersion	/ dIs'pE:S(q)n /	рассеивание; распространение
embrace	/ Im'breIs /	включать; охватывать
emerge	/ I'mE:G /	появляться, возникать
feature	/ 'fJCq /	особенность; характерная черта; элемент
handle	/ 'hxndl /	управлять, регулировать; справляться
identify	/ aI'dentIfaI /	устанавливать, определять; опознавать, распознавать
impact	/ 'Impxkt /	влияние, воздействие
imply	/ Im'plaI /	значить, подразумевать
incorporate	/ In'kLp(q)reIt /	соединять(ся), объединять(ся); включать
leap	/ lJp /	прыжок, скачок
novel	/ 'nPv(q)l /	неизвестный; новый

Part A

1. Compare the meanings of the following English words with the Russian ones. They may have different meanings.

Nanotechnology, term, phenomenon, utilize, design, production, structure, potential, individual, organization, film, optical, cosmetics, communication, technology, interference, physiology, generate, central, evolution, nature.

2. Define the following words as parts of speech and give the initial words of the following derivatives.

Engineering, characterization, application, experienced, assumption, embracing, environmental, protection, emergence, encountered, versatility, inorganic, semiconductor, incorporation, capability, novelize, quantum, computing, identification.

3. From the given words form a) nouns; b) adjectives; c) adverbs and translate them into Russian:

a) build, compute, function, calculate, pollute, limit, inform, imply, reduce, produce, interfere, differ, develop;

b) environment, electron, tradition, optics, significance, benefit, science, atom, differ;

c) radical, ready, especial, intentional, actual, direct, common, previous, wide, undoubted.

4. Fill in the gaps with the words derived from the words in brackets.

Nanotechnology, shortened to "nanotech", is the study of the control of matter on an (*atom*) and molecular scale. (*General*) nanotechnology deals with structures of the size 100 nanometers or smaller. Nanotechnology is very diverse, ranging from extensions of (*convention*) device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nanoscale to investigating whether we can (*direct*) control matter on the (*atom*) scale.

Nanotechnology has the potential to create many new materials and devices with a vast range of (*apply*), such as in medicine, (*electron*) and energy (*produce*).

5. Find words in paragraph 2 of the text which mean:

1) the force of impression of one thing on another;
2) practical purpose for which a machine, idea etc. can be used;
3) having a good effect;
4) a characteristic quality of anything;
5) any fact or happening which can be observed or can be known through the senses;
6) a very thin layer of a substance on a supporting material;
7) a microscopic particle whose size is measured in nanometers;
8) taking in or including as a part, item, or element of a more inclusive whole;
9) a branch of electronics that deals with electronic devices for emitting, modulating, transmitting, and sensing light;
10) difficulties in a job.

6. Fill in the gaps with one of the following words: **impact, features, challenge, novel, emerge, deliver, incorporated, assumed.**

1. Unusual physical, chemical, and biological properties can … in materials at the nanoscale.
2. In the application of the substance, these individual particles may be … into a quantity of another substance, which could be a gas, a liquid or a solid.
3. Perhaps the greatest … to benefiting from nanotechnology is having the foresight to develop and use it wisely.
4. As a new field, nanotechnology is just beginning to … on its promise.
5. In addition, nanoparticles may also spread and persist in the environment, and therefore have an … on the environment.
6. This report has … that, unless otherwise stated, "ultrafine particles" are essentially equivalent to nanoparticles.
7. … mechanical properties of nanomaterials is a subject of nanomechanics research.
8. Many chemicals and chemical processes have nanoscale … .

7. Read the text and name the key points raised in it.

What Is Nanotechnology?

Nanotechnology is the term given to those areas of science and engineering where phenomena that take place at dimensions in the nanometre scale are utilised in the design, characterisation, production and application of materials, structures, devices and systems.

Clearly the various forms of nanotechnology have the potential to make a very significant impact on society. In general it may be assumed that the application of nanotechnology will be very beneficial to individuals and organisations. Many of these applications involve new materials which provide radically different properties through functioning at the nanoscale, where new phenomena are associated with the very large surface area to volume ratios experienced at these dimensions and with quantum effects that are not seen with larger sizes. These include materials in the form of very thin films used in catalysis and electronics, two-dimensional nanotubes and nanowires for optical and magnetic systems, and as nanoparticles used in cosmetics, pharmaceuticals and coatings. The industrial sectors most readily embracing nanotechnology are the information and communications sector, including electronic and optoelectronic fields, food technology, energy technology and the medical products sector. Nanotechnology products may also offer novel challengies for the reduction of environmental pollution.

However, just as phenomena taking place at the nanoscale may be quite different to those occurring at larger dimensions and may be exploitable for the benefit of mankind, so these newly identified processes and their products may expose the same humans, and the environment in general, to new health risks, possibly involving quite different mechanisms of interference with the physiology of human and environmental species. These possibilities may well be focussed on the fate of free nanoparticles generated in nanotechnology processes and either intentionally or unintentionally released into the environment, or actually delivered directly to individuals through the functioning of a nanotechnology basic product. Of special concern would be those individuals whose work places them in regular and sustained contact with free nanoparticles. Central to these health risk concerns is the fact that evolution has determined that the human species has developed mechanisms of protection against environmental agents, either living or dead, this process being determined by the nature of the agents commonly encountered, within which size is an important factor. The exposure to nanoparticles having characteristics not previously encountered may well challenge the normal defence mechanisms associated with, for example, immune and inflammatory systems. It is also possible for there to be an environmental impact of the products of nanotechnology, related to the processes of dispersion and persistence of nanoparticles in the environment.

Wherever the potential for an entirely new risk is identified, it is necessary to carry out an extensive analysis of the nature of the risk, which can then, if necessary, be used in the processes of risk management. It is widely accepted that the risks associated with nanotechnology need to be analysed in this way.

8. Read the following statements and say whether they are true or false. Correct the false ones.

1. Nanotechnology deals with systems designed and manufactured at the scale of the atom, or the nanometer scale.
2. It may be assumed that the various forms of nanotechnology don't make any impact on society.
3. The information and communications sector, including electronic and optoelectronic fields most readily embraces nanotechnology.
4. Nanotechnology can reduce environmental pollution.
5. The phenomena taking place at the nanoscale are the same as those occurring at larger dimensions.
6. Nanotechnology cannot do any harm to humans.
7. Those individuals who work in regular and sustained contact with free nanoparticles should be very careful.
8. There is no need to take into account the risks associated with nanotechnology.

9. Express your attitude to the importance of nanotechnology.

10. Using the information from the text speak about the benefits and disadvantages of nanotechnology.

11. Make an outline of the text.

12. Make a short summary of the text in written form using your outline.

Part B

13. Scan the text and choose the best title.

1. Nanotechnology and Nanostructures;
2. Introduction to Nanotechnology;
3. Nanotechnology and Electronics;
4. Nanoscience and Nanotechnology.

14. Divide the text into logical parts. Entitle each part.

15. Read the text and write out key words and phrases revealing the contents of each part.

Text B

Nanotechnology is already being used by the electronic industry and you will be surprised to know that many of today's electronics have already incorporated many applications that the nanotechnology science has developed. For example, new computer microprocessors have less than 100 nanometers (nm) features. Smaller sizes mean a significant increase in speed and more processing capability.

These advances will undoubtedly help achieve better computers. However, at some point in time (very near in the future) current electronic technology will no longer be enough to handle the demand for new chips microprocessors. Right now, the method for chip manufacturing is known as lithography or etching. This way of building circuits in electronic chips has a limitation of around 22 nanometers (most advanced chip processors uses 60 – 70 nm size features). Below 22 nm errors will occur and short circuits and silicon limitations will prevent chip manufacturing.

Nanotechnology may offer new ways of working for electronics. Nanotechnology science is developing new circuit materials, new processors, new means of storing information and new manners of transferring information. Nanotechnology can offer greater versatility because of faster data transfer, more "on the go" processing capabilities and larger data memories.

A new field is emerging in electronics that will be a giant leap in computer and electronics science. It is the field of quantum computing and quantum technology. Quantum computing is area of scientific knowledge aimed at developing computer technology based on the principles of quantum theory. In quantum computing the "qbit" instead of the traditional bit of information is used. Traditionally, a bit can assume two values: 1 and 0. All the computers up-to-date are based on the "bit" principle. However, the new "qbit" is able to process anything between 0 and 1. This implies that new types of calculations and high processing speeds can be achieved.

We are bound to see many nanotechnological applications within the electronic industry in the near future. These will undoubtedly increase the quality of life of our society.

16. Find the sentences containing:

a) the main idea of the text;
b) the examples of use of nanotechnology in electronics;
c) the information about future development of nanotechnology;
d) the description of quantum computing.

17. Express your attitude to the facts given in the text. You may use the following phrases:

– It is full of interesting information…
– I find the text rather / very cognitive…
– I've learnt a lot …
– I don't agree with …

18. Give the summary of the text using the key words, phrases and the outline.

19. Say which facts presented in the text you've already been familiar with.

Part C

20. Look through the following text, define the information presented and entitle it.

Text C

Nanomaterials is a field which takes a materials science-based approach to nanotechnology. It studies materials with morphological features on the nanoscale, and especially those which have special properties stemming from their nanoscale dimensions. Nanoscale is usually defined as smaller than a one tenth of a micrometer in at least one dimension, though this term is sometimes also used for materials smaller than one micrometer.

Materials referred to as “nanomaterials” generally fall into two categories: fullerenes, and inorganic nanoparticles.

The fullerenes are a class of allotropes of carbon which conceptually are graphene sheets rolled into tubes or spheres. These include the carbon nanotubes (or silicon nanotubes) which are of interest both because of their mechanical strength and also because of their electrical properties.

For the past decade, the chemical and physical properties of fullerenes have been a hot topic in the field of research and development, and are likely to continue to be for a long time.

Nanoparticles or nanocrystals made of metals, semiconductors, or oxides are of particular interest for their mechanical, electrical, magnetic, optical, chemical and other properties. Nanoparticles have been used as quantum dots and as chemical catalysts.

Nanoparticles are of great scientific interest as they are effectively a bridge between bulk materials and atomic or molecular structures. A bulk material should have constant physical properties regardless of its size, but at the nano-scale this is often not the case.

21. Find the following information in the text:

a) what nanomaterials are;
b) what categories nanomaterials fall into;
c) what the fullerenes are;
d) why nanoparticles are of great scientific interest.

22. Say where the information presented in the text can be used.

UNIT III
MICROFABRICATION

Word List

align	/ q'laIn /	выстраивать в линию, ставить в ряд; выравнивать
application	/ "xplI'keISqn /	применение, использование; приложение
bulk	/ bAlk /	груда, кипа; масса
density	/ 'densItI /	плотность; концентрация
device	/ dI'vaIs /	устройство, приспособление; механизм; аппарат, машина, прибор
deposition	/"depq'zISqn /	отложение; осаждение
enable	/ I'neIbl /	давать возможность, право
evaporation	/ I"vxpq'reISqn /	испарение, выпаривание; парообразование

feature	/ 'fi:tSq /	особенность, характерная черта; деталь, признак, свойство
gear	/ glq /	механизм, устройство, инструмент, прибор
humidity	/ hju:'mldltl /	сырость, влажность
pervasive	/ pq:'velslv /	распространяющийся, проникающий, пропитывающий, заполняющий
precede	/ prl'si:d /	предшествовать
semiconductor	/ "semlkqn'dAktq /	полупроводник
substrate	/ 'sAbstrelt /	основа, подложка
versatility	/ "vq:sq'tllltl /	непостоянство, изменчивость; многосторонность, разносторонность
wafer	/ 'welfq /	подложка; пластина

Part A

1. Define the following words as parts of speech and give the initial words of the following derivatives.

Earliest, integrated, fabrication, processing, repeatedly, handling, productive, deposition, contaminated, reconstruct, completely, sophisticated, actually.

2. Read the following words in each line and define their roots. Translate the words into Russian:

1) technical, technique, technically;
2) scale, scaling, scaled;
3) classify, classified, classification;
4) application, applied, apply;
5) fabricate, fabrication, fabricator;
6) designer, designing, design;
7) process, processing, processed;
8) conduct, conductor, conductive, semiconductor.

3. Match the following terms with their definitions.

1) miniaturize	a) a thin coating or layer
2) substrate	b) make dirty, impure or diseased
3) semiconductor	c) putting to practical use
4) contaminate	d) easy to see through
5) transparent	e) to make or construct (something, esp. electronic equipment) on a very small scale; reduce in size
6) particle	f) the semiconductor base on which other material is deposited, esp. in the construction of integrated circuits
7) application	g) a body with finite mass that can be treated as having negligible size, and internal structure
8) film	h) a substance, such as germanium or silicon, that has an

	electrical conductivity that increases with temperature and is intermediate between that of a metal and an insulator

4. Translate the following sentences paying attention to the words in bold type.

1. Microfabrication technologies originate from the microelectronics industry, and the devices are usually made on **silicon wafers.**

2. Microfabrication is actually a collection of technologies which **are utilized** in making microdevices.

3. **The substrate** enables easy **handling** of the microdevice through the many fabrication steps.

4. **To fabricate** a microdevice, many processes must be performed, one after the other, many times repeatedly.

5. The complexity of microfabrication processes can be described by their "**mask count**".

6. Microfabricated devices are not generally **freestanding devices** but are usually formed over or in a thicker **support substrate**.

5. Read the text and name the key points raised in it.

6. Divide the text into logical parts and entitle them.

Microfabrication

Microfabrication or micromanufacturing are the terms to describe processes of fabrication of miniature structures, of micrometre sizes and smaller. Historically the earliest micromanufacturing was used for semiconductor devices in integrated circuit fabrication and these processes have been covered by the term "semiconductor device fabrication", "semiconductor manufacturing", etc. Miniaturization of various devices presents challenges in many areas of science and engineering: physics, chemistry, material science, computer science, ultra-precision engineering, fabrication processes, and equipment design. It is also giving rise to various kinds of interdisciplinary research. The major concepts and principles of micromanufacturing are laser technology, microlithography, micromachining and microfinishing (nanofinishing).

Microfabrication technologies originate from the microelectronics industry, and the devices are usually made on silicon wafers even though glass, plastics and many other substrate are in use. Micromachining, semiconductor processing, microelectronic fabrication, semiconductor fabrication, MEMS[1] fabrication and integrated circuit technology are terms used instead of microfabrication, but microfabrication is the broad general term.

Traditional machining techniques such as "electro-discharge machining", "spark erosion machining", and "laser drilling" have been scaled from the millimeter size range to micrometer range, but they do not share the main idea of microelectronics-originated microfabrication: replication and parallel fabrication of hundreds or millions of identical structures. This parallelism is present in various imprint, casting and molding techniques which have successfully been applied in the microregime. For example, injection moulding of compact discs involves fabrication of micrometer-sized spots on the disc.

Microfabrication is actually a collection of technologies which are utilized in making microdevices. Some of them have very old origins, not connected to manufacturing, like lithography or etching. Polishing was borrowed from optics manufacturing, and many of the vacuum techniques come from 19th century physics research. Electroplating[2] is also a 19th century technique adapted to produce micrometre scale structures, as are various stamping and embossing techniques.

To fabricate a microdevice, many processes must be performed, one after the other, many times repeatedly. These processes typically include depositing a film, patterning the film with the desired micro features, and removing (or etching) portions of the film. For example, in memory chip fabrication there are some 30 lithography steps, 10 oxidation steps, 20 etching steps, 10 doping steps, and many others are performed. The complexity of microfabrication processes can be described by their "mask count". This is the number of different pattern layers that constitute the final device. Modern microprocessors are made with 30 masks while a few masks suffice for a microfluidic device or a laser diode. Microfabrication resembles multiple exposure photography, with many patterns aligned to each other to create the final structure.

Microfabricated devices are not generally freestanding devices but are usually formed over or in a thicker support substrate. For electronic applications, semiconducting substrates such as silicon wafers can be used. For optical devices or flat panel displays, transparent substrates such as glass or quartz are common. The substrate enables easy handling of the micro device through the many fabrication steps. Often many individual devices are made together on one substrate and then singulated into separated devices toward the end of fabrication.

Microfabrication is carried out in cleanrooms, where air has been filtered of particle contamination and temperature, humidity, vibrations and electrical disturbances are under stringent control. Smoke, dust, bacteria and cells are micrometers in size, and their presence will destroy the functionality of a microfabricated device. Cleanrooms provide passive cleanliness but the wafers are also actively cleaned before every critical step.

Notes:

[1]MEMS – Micro Electro Mechanical Systems – микроэлектромеханические системы, технология MEMS (фотолитографическая технология, позволяющая изготавливать интегрированные кремниевые микросхемы размером от десятков микрон до нескольких миллиметров с крошечными механическими элементами – интеллектуальные устройства (микромашины) с самыми разными функциями.);

[2]electroplating – гальваностегия, нанесение покрытия методом электроосаждения, нанесение гальванического покрытия.

7. Read the following statements and say whether they are true or false. Correct the false ones.

1. Historically semiconductor devices were made with the help of microfabrication.
2. Only a few technologies are used in making microdevices.
3. Modern microprocessors are composed of many different masks.
4. Silicon wafers can be employed in production of many electronic devices.
5. Some devices can be mounted on one substrate and then separated toward the end of fabrication.
6. Different contaminations can affect the functionality of a microdevice.

8. Match parts A and B to complete the sentences.

A	B
1. Miniaturization of various devices presents challenges …	a) the microelectronics industry.
2. The major concepts and principles of micromanufacturing are …	b) with 30 masks.
3. Microfabrication technologies originate from …	c) in many areas of science and engineering.
4. Modern microprocessors are made …	d) laser technology, microlithography, micromachining and microfinishing.
5. Microfabrication is carried out …	e) in cleanrooms, where air has been filtered of particle contamination and temperature.

9. Using the information from the text speak about the fabrication of microdevices.

10. Make an outline of the text.

11. Make a short summary of the text in written form using your outline.

Part B

12. Look at the title. Make your predictions about the contents of the text.

13. Read the text and write out key words and phrases revealing its contents.

14. Divide the text into logical parts. In each part find the key sentence.

Micro Electro Mechanical Systems

The term MEMS[1], for Micro Electro Mechanical Systems, was coined in the 1980's to describe new, sophisticated mechanical systems on a chip, such as micro electric motors, resonators, gears, and so on. Today, the term MEMS in practice is used to refer to any microscopic device with a mechanical function, which can be fabricated in a batch process (for example, an array of microscopic gears fabricated on a microchip would be considered a MEMS device but a tiny laser-machined stent or watch component would not). In Europe, the term MST for Micro System

Technology is preferred, and in Japan MEMS are simply referred to as "micromachines". The distinctions in these terms are relatively minor and are often used interchangeably.

Though MEMS processes are generally classified into a number of categories – such as surface machining, bulk machining – there are indeed thousands of different MEMS processes. Some produce fairly simple geometries, while others offer more complex 3-D geometries and more versatility. A company making accelerometers for airbags would need a completely different design and process to produce an accelerometer for inertial navigation. Changing from an accelerometer to another inertial device such as a gyroscope[2] requires an even greater change in design and process, and most likely a completely different fabrication facility and engineering team.

In one viewpoint MEMS application is categorized by type of use: sensor, actuator[3], structure.

In another view point MEMS applications are categorized by the field of application:

– Inkjet printers.

– Accelerometers in modern cars for a large number of purposes including airbag deployment in collisions.

– Accelerometers in consumer electronics devices such as game controllers, personal media players / cell phones. Also used in PCs to park the hard disk head when free-fall is detected, to prevent damage and data loss.

– MEMS gyroscopes used in modern cars and other applications to detect yaw[4].

– Silicon pressure sensors e.g. car tire pressure sensors, and disposable blood pressure sensors.

– Optical switching technology which is used for switching technology and alignment for data communications.

– Bio-MEMS applications in medical and health related technologies.

– Interferometric modulator display[5] (IMOD) applications in consumer electronics (primarily displays for mobile devices).

Notes:
[1]MEMS – микроэлектромеханические системы;
[2]gyroscope – гироскоп;
[3]actuator – силовой привод; воздействующее устройство;
[4]yaw – отклонение от направления движения;
[5]interferometric modulator display – дисплей интерферометрического модулятора.

15. Make questions to the text to interview your partner about MEMS.

16. Speak about MEMS applications.

17. Say what new information you have learnt from the text.

18. Sum up the text using the key words, word combinations and the topical sentences.

Part C

19. Look through the following text, define its main idea and entitle the text.

Text C

Micromachines are mechanical objects that are fabricated in the same general manner as integrated circuits. They are generally considered to be between 100 nanometres to 100 micrometres in size, though that is debatable. The applications of micromachines include accelerometers that detect when a car has hit an object and trigger an airbag. Complex systems of gears and levers are another application.

Most micromachines act as transducers[1]; in other words, they are either sensors or actuators.

Sensors convert information from the environment into interpretable electrical signals. One example of a micromachine sensor is a resonant chemical sensor. A lightly damped mechanical object vibrates much more at one frequency than any other, and this frequency is called its resonance frequency. A chemical sensor is coated with a special polymer that attracts certain molecules and when those molecules attach to the sensor, its mass increases. The increased mass alters the resonance frequency of the mechanical object, which is detected with circuitry.

Actuators convert electrical signals and energy into motion of some kind. The three most common types of actuators are electrostatic, thermal, and magnetic. Electrostatic actuators use the force of electrostatic energy to move objects. Two mechanical elements, one that is stationary (the stator) and one that is movable (the rotor) have two different voltages applied to them, which creates an electric field. The field competes with a restoring force on the rotor (usually a spring force produced by the bending or stretching of the rotor) to move the rotor. The greater the electric field, the farther the rotor will move. Thermal actuators use the force of thermal expansion to move objects. When a material is heated, it expands and amount depending on material properties. Two objects can be connected in such a way that one object is heated more than the other and expands more, and this imbalance creates motion. The direction of motion depends on the connection between the objects.

Note:
[1]transducer – преобразователь; датчик; приемник.

20. Find the following information in the text:
a) what micromachines are;
b) how micromachines act;
c) what the size of micromachines is.

21. Say what you have learnt about micromachines.

UNIT IV

INFORMATION PROTECTION

Word List

access	/ 'xkses /	доступ
authority	/ O:'TPrItI /	власть; полномочия
available	/ q'veIlqbl /	доступный
cancel	/ 'kxnsql /	отменить
capability	/ "keIpq'bIlItI /	способность
consent	/ kqn'sent /	согласие
contribution	/ "kPntrI'bju:Sqn /	вклад
disclose	/ dIs'klquz /	раскрыть
design	/ dI'zaIn /	проект
distinct	/ dIs'tINkt /	отдельный, отличный
evaluate	/ I'vxljueIt /	оценить
facilitate	/ fq'sIlIteIt /	облегчить
flaw	/ flO: /	недостаток
govern	/ 'gAvqn /	управлять
hardware	/ 'hQ:dweq /	аппаратные средства
implement	/ 'ImplImqnt /	прибор; выполнять
label	/ 'leIbl /	маркировать
mandatory	/ 'mxndqtqrI /	принудительный
moderate	/ 'mPd(q)reIt /	умерять, ослаблять
overflow	/ 'quvqflqu /	выходить за пределы
process	/ 'prquses /	обрабатывать
protect	/ prq'tekt /	защищать
reassure	/ "ri:q'Suq /	заверить
scheme	/ ski:m /	схема
storage	/ 'stO:rIdZ /	хранение

Part A

1. Define the following words as parts of speech and give the initial words of the following derivatives.

Accession, application, cancellation, capability, contribution, disclose, evaluating, government, moderation, processing, protection, storage, reassure.

2. Translate the following words paying attention to the suffixes and the prefixes.

Economical, application, identical, additional, responsible, self-protection, functional, categorization, unprotected, widely, commonly, acceptability, impossible.

3. Study the following words and choose:

a) nouns:

1) apply, application, applied, applicant, appliance;
2) processing, process, processor, procession;
3) protection, protect, protectioning, protectional;
4) information, inform, informative, informer;

b) adjectives:

1) differ, differently, difference, different;
2) availability, avail, available;
3) accessibility, access, accession, accessible;
4) direct, direction, directly, directness.

4. Match the words with their definitions.

1) apply	a) electronic device for storing and processing data
2) access	b) to carry out a process on data for a particular purpose, may be carried by a person or by a computer
3) process	c) to use something such as a method, idea, or law in a particular situation, activity, etc.
4) computer	d) the right to enter a place, use something, see someone
5) design	e) able to be used or can easily be bought or found
6) available	f) construct or manufacture
7) hardware	g) to make information known
8) scheme	h) a systematic plan for a course of action
9) disclose	i) the physical equipment used in a computer system, such as the central processing unit, peripheral devices, and memory

5. Fill in the gaps with the words derived from the words in brackets.

1. Many of these new (*applicant*) involve both storing information and simultaneous use by several individuals.

2. A flight boarding agent might have the (*addition*) authority to print out the list of all passengers.

3. The airline example is one of (*protect*) of corporate information for corporate self-protection.

4. It is convenient to divide protection schemes according to their (*function*) properties.

5. These are systems that provide (*isolate*) of users, sometimes (*moderate*) by total sharing of some pieces of information.

6. Translate the following sentences paying attention to the words in bold type. What part of speech do they belong to?

1. It is not always easy to separate **hardware and software** and this fact has been demonstrated on several occasions in the courts.

2. We like fast computers, the latest **operating system**, neat software and expensive peripherals as much as anyone.

3. In addition, many companies make **contributions** to employee retirement plans at the start of the year.

4. A **scheme** to share the costs between insurers and taxpayers has been agreed to, but Parliament has yet to approve it.

5. Security is maintained by terminal operators using unique **identification** and password codes to gain **access** to the system.

6. Internet Explorer and Netscape, for example, can restrict access according to a **rating system.**

7. A computer has a wide range of **applications** for businesses.

8. The new network will enable **data** to be processed more speedily.

7. Fill in the gaps with one of the following words: **reservation, protection, understood, schemes, sharing, library.**

1. As computers become better … and more economical, every day brings new applications.

2. In an airline seat reservation system, a … agent might have authority to make reservations.

3. The airline example is one of … of corporate information for corporate self-protection.

4. It is convenient to divide protection … according to their functional properties.

5. These are systems that provide isolation of users, sometimes moderated by total … of some pieces of information.

6. In some cases the public … mechanism may be extended to accept user contributions.

8. Read the text and name the key points raised in it.

Basic Principle of Information Protection

1. General Observations: As computers become better understood and more economical, every day brings new applications. Many of these new applications involve both storing information and simultaneous use by several individuals. The key concern in this paper is multiple use. For those applications in which all users should not have identical authority, some scheme is needed to ensure that the computer system implements the desired authority structure.

For example, in an airline seat reservation system, a reservation agent might have authority to make reservations and to cancel reservations for people whose names he can supply. A flight boarding agent might have the additional authority to print out the list of all passengers who hold reservations on the flights for which he is responsible. The airline might wish to withhold from the reservation agent the authority to print out a list of reservations, so as to be sure that a request for a passenger list from a law enforcement agency is reviewed by the correct level of management. The airline example is one of protection of corporate information for corporate self-protection (or public interest, depending on one's view).

2. Functional Levels of Information Protection: Many different designs have been proposed and mechanisms implemented for protecting information in computer systems. One reason for differences among protection schemes is their different functional properties – the kinds of access control that can be expressed naturally and enforced. It is convenient to divide protection schemes according to their functional properties. A rough categorization is the following:

a) unprotected systems. Some systems have no provision for preventing a determined user from having access to every piece of information stored in the system. Although these systems are not directly of interest here, they are worth mentioning since, as of 1975, many of the most widely used, commercially available batch data processing systems fall into this category – for example, the Disk Operating System for the IBM System. Our definition of protection, which excludes features usable only for mistake prevention, is important here since it is common for unprotected systems to contain a variety of mistake-prevention features. These may provide just enough control that any breach of control is likely to be the result of a deliberate act rather than an accident. Nevertheless, it would be a mistake to claim that such systems provide any security;

b) all-or-nothing systems. These are systems that provide isolation of users, sometimes moderated by total sharing of some pieces of information. If only isolation is provided, the user of such a system might just as well be using his own private computer, as far as protection and sharing of information are concerned. More commonly, such systems also have public libraries to which every user may have access. In some cases the public library mechanism may be extended to accept user contributions, but still on the basis that all users have equal access.

Briefly, then, we may outline our discussion to this point. The application of computers to information handling problems produces a need for a variety of security mechanisms. We are focusing on one aspect, computer protection mechanisms - the mechanisms that control access to information by executing programs. Finally, some protection designs can be evaluated by comparing the resources of a potential attacker with the work factor required to defeat the system, and compromise recording may be a useful strategy.

9. Read the following statements and say whether they are true or false. Correct the false ones.

1. Computers become more economical and bring new applications.
2. These new applications involve only storing information.
3. Different functional properties is the reason for differences among protection schemes.
4. Protection schemes are not convenient to divide according to their functional properties.
5. Every system has provision for preventing a determined user from having access to every piece of information stored in the system.
6. All-or-nothing systems have no public libraries which are accessible to every user.

10. Using information of paragraph 2 speak about a reservation system.

11. Make an outline of the text.

12. Make a short summary of the text in written form using your outline.

Part B

13. Look at the title of the text. Make your predictions about its contents.

14. Read the text and write out key words and phrases revealing the contents of the text.

15. Divide the text into logical parts. In each part find the key sentence.

16. Find one or two sentences which can be omitted as inessential in each logical part.

Descriptor-Based Protection Systems

Descriptors have been introduced for the purpose of protecting information, although they are also used in some systems to organize addressing and storage allocation. For the present, it is useful to separate such organizational uses of descriptors from their protective use by requiring that all memory accesses go through two levels of descriptors. In many implementations, the two levels are actually merged into one, and the same descriptors serve both organizational and protection purposes.

Conceptually, we may achieve this separation by enlarging the function of the memory system to provide uniquely identified (and thus distinctly addressed) storage areas, commonly known as segments. For each segment there must be a distinct addressing descriptor, and we will consider the set of addressing descriptors to be part of the memory system. Every collection of data items worthy of a distinct name, distinct scope of existence, or distinct protection would be placed in a different segment, and the memory system itself would be addressed with two-component addresses: a unique segment identifier (to be used as a key by the memory system to look up the appropriate descriptor) and an offset address that indicates which part of the segment is to be read or written. All users of the memory system would use the same addressing descriptors, and these descriptors would have no permission bits – only a base and a bound value.

The unique identifiers used to label segments are an essential cornerstone of this organization. They will be used by the protection system to identify segments, so they must never be reused. One way of implementing unique identifiers is to provide a hardware counter register that operates as a clock (counting, say, microseconds) and is large enough never to overflow in the lifetime of the memory system. The value of the clock register at the time a segment is created can be used as that segment's unique identifier. As long as the memory system remembers anything, the time base of the clock register must not be changed.

Since the addressing descriptors are part of the memory system, which is shared by all processors, the system address space is universal. Any single processor address space, on the other hand, is defined by the particular protection descriptors associated with the processor and therefore is local. If the supervisor switches control of a real processor from one virtual processor to another, it would first reload the protection descriptors; the processor address space thus is different for different users, while the system address space remains the same for all users.

With the addressing function separated architecturally from the protection function, we may now examine the two generalized forms of protection systems: the capability system and the access control list system.

17. Make questions to the text, interview your partner on the problems raised in it.

18. Express your attitude to the facts given in the text. You may use the following phrases:

– It is full of interesting information …

– I find the text rather/very cognitive…

– I've learnt a lot …

– I don't agree with…

19. Say which facts presented in the text you've already been familiar with.

Part C

20. Read the title of the following text. Make your predictions about the contents of the text.

21. Read the text and find out the topical sentences in each paragraph.

The Personal Information Protection and Electronic Documents Act

The Personal Information Protection and Electronic Documents Act (abbreviated PIPEDA or PIPED Act) is a Canadian law relating to data privacy. It governs how private-sector organizations collect, use and disclose personal information in the course of commercial business. In addition, the Act contains various provisions to facilitate the use of electronic documents. PIPEDA was passed in the late 1990s to promote consumer trust in electronic commerce. The act was also intended to reassure the European Union that the Canadian privacy law was adequate to protect the personal information of European citizens. PIPEDA incorporates and makes mandatory provisions of the Canadian Standards Association's Model Code for the Protection of Personal Information, developed in 1995.

"Personal Information", as specified in PIPEDA, is as follows: information about an identifiable individual, but does not include the name, title or business address or telephone number of an employee of an organization. The law gives individuals the right to know why an organization collects, uses or discloses their personal information; expect an organization to collect, use or disclose their personal information reasonably and appropriately, and not use the information for any purpose other than that to which they have consented.

The law requires organizations to:

– obtain consent when they collect, use or disclose their personal information;

– supply an individual with a product or a service even if they refuse consent for the collection;

– collect information by fair and lawful means; and have personal information policies that are clear, understandable and readily available.

22. Say what you have learnt about the PIPEDA.

UNIT V

COMPUTER SECURITY

Word list

application code	/ "xplI'keISqn 'kqud /	код приложения
computer security	/ kqm'pju:tq sI'kjuqrItI /	компьютерная безопасность
compromise	/ 'kPmprqmaIz /	компрометировать, заниматься несанкционированным раскрытием или получением защищенной информации
corrupt	/ kq'rApt /	искажать; уничтожать, разрушать данные
encrypt	/ en'krIpt /	шифровать
execution	/ "eksI'kju:Sqn /	исполнение, выполнение (программ, команд)
flawlessly	/ 'flO:lIslI /	безупречно, безукоризненно
impenetrable	/ Im'penItrqbl /	неприступный, недоступный
implement	/ 'ImplImqnt /	осуществлять, внедрять
kernel	/ 'kF:nql /	ядро
malicious	/ mq'lISqs /	несанкционированный
overflow	/ "quvq'flqu /	переполнение
privilege level	/ 'prIvIlIdZ 'levl /	уровень доступа
robust	/ rP'bAst /	надежный, устойчивый к ошибкам
scrutiny	/ 'skru:tInI /	тщательная проверка
security policy	/ sI'kjuqrItI 'pPlIsI /	политика безопасности
verifiable	/ 'verIfaIqbl /	поддающийся проверке, контролю

Part A

1. Define the following words as parts of speech and give the initial words of the following derivatives.

Management, impenetrable, configuration, deterministic, verifiable, assurance, capability, functionality, protection, correctness.

2. Find the words and phrases in paragraph 1 that mean the same.

a) a system in a computer that helps all the programs in it to work;

b) safe from and protected against damage and attacks;

c) to keep someone/ something safe from harm, damage;

d) measures taken in order to keep someone/ something safe from harm, damage.

3. Translate the following sentences paying attention to the words in bold type.

1. None of the top 10 clonemakers now sells computers that run the Macintosh **operating system.**

2. The new mainframe **operating system** I have personally approved is going haywire; the computer is down half the time.

3. We like fast computers, the latest operating system, **software** and expensive peripherals.

4. A company can **protect** information of this kind only as long as it is confidential to the business and not in the public domain.

5. The decision he reached was that existing computer **hardware** was not sufficiently powerful to cope with the problem.

6. But another factor is that instruction manuals that usually accompany new computer **hardware and software** are difficult to understand.

7. The belief that it would be possible to maintain old computer **hardware** in operational order for use by future historians is utopian.

8. Please supply a **valid** name and password.

9. This computer system gives the user the capability of accessing huge amounts of **data**.

10. Both computers had a 28, 800-baud fax modem, 16 megabytes of random-access **memory** and voice mail / speakerphone capabilities.

11. The company has spent millions of dollars replacing outdated computer **hardware**.

12. The market permits people to make decisions and to act without going through the impossible task of collecting all the relevant **information.**

4. Fill in the missing words: **assure, operating systems, hardware, security, web servers, produce.**

1. The term "high assurance" usually suggests the system has the right … functions.

2. The design methodology to … such secure systems is precise, deterministic and logical.

3. The strategy is based on a coupling of special microprocessor … features.

4. Secure … … designed this way are used primarily to protect national security information, military secrets, and the data of international financial institutions.

5. These systems are found in use on … … , guards, database servers, and management hosts.

6. Ordinary operating systems, on the other hand, lack the features that … this maximal level of security.

5. Read the text and find out the words to prove the title of the text.

6. Read the following text. Choose the sentences covering the main idea of the text.

Computer Security

One use of the term computer security refers to technology to implement a secure operating system. Much of this technology is based on science developed in the 1980s and used to produce what may be some of the most impenetrable operating systems ever. Though still valid, the technology is in limited use today, primarily because it imposes some changes to system management and also because it is not widely understood. Such ultra-strong secure operating systems are based on operating system kernel technology that can guarantee that certain security policies are absolutely enforced in an operating environment. An example of such a Computer security policy is the Bella-La Padula model. The strategy is based on a coupling of special microprocessor hardware features, often involving a memory management unit, to a special correctly implemented operating system kernel. This forms the foundation for a secure operating system which, if certain critical parts are designed and implemented correctly, can ensure the absolute impossibility of penetration by hostile elements. This capability is enabled because the configuration not only imposes a security policy, but in theory completely protects itself from corruption.

Ordinary operating systems, on the other hand, lack the features that assure this maximal level of security. The design methodology to produce such secure systems is precise, deterministic and logical. Systems designed with such methodology represent the state of the art of computer security although products using such security are not widely known. In sharp contrast to most kinds of software, they meet specifications with verifiable certainty comparable to specifications for size, weight and power. Secure operating systems designed this way are used primarily to protect national security information, military secrets, and the data of international financial institutions. These are very powerful security tools and very few secure operating systems have been certified at the highest level "unclassified". The assurance of security depends not only on the soundness of the design strategy, but also on the assurance of correctness of the implementation.

The term "high assurance" usually suggests the system has the right security functions that are implemented robustly enough to protect DOD[1] and DOE[2] classified information. Medium assurance suggests it can protect less valuable information, such as income tax information. Secure operating systems designed to meet medium robustness levels of security functionality and assurance have seen wider use within both government and commercial markets. Medium robust systems may provide the same security functions as high assurance secure operating systems but do so at a lower assurance level. Lower levels mean we can be less certain that the security functions are implemented flawlessly, and therefore less dependable. These systems are found in use on web servers, guards, database servers, and management hosts and are used not only to protect the data stored on these systems but also to provide a high level of protection for network connections and routing services.

Notes:
[1]DOD – Department of Defense – Министерство обороны США;
[2]DOE – Department of Energy – Министерство энергетики (США).

7. Match parts A and B to complete the sentences.

A	B
1. The configuration …	a) that the security functions are implemented flawlessly.
2. These are very powerful security tools …	b) are based on operating system kernel technology.
3. The strategy is based on a coupling of …	c) less valuable information.
4. Lower levels mean we can be less certain …	d) completely protects itself from corruption.
5. Such ultra-strong secure operating systems …	e) and very few secure operating systems have been certified at the highest level “unclassified”.
6. Medium assurance suggests it can protect …	f) special microprocessor hardware units to a special operating system kernel.

8. Read paragraph 2 and describe the essence of “*high assurance of computer security*”.

9. Express your attitude to the importance of “*computer security*”.

10. Make an outline of the text.

11. Make a short summary of the text in written form using your outline.

Part B

12. Look at the title. Make your own predictions about the contents of the text.

13. Read the text and write out key words and phrases revealing the contents of the text.

Secure Coding

If the operating environment is not based on a secure operating system capable of maintaining a domain for its own execution, and capable of protecting application code from malicious subversion, and capable of protecting the system from subverted code, then high degrees of security are understandably not possible. While such secure operating systems are possible and have been implemented, most commercial systems fall in a “low security” category because they rely on features not supported by secure operating systems (like portability, et al.). In low security operating environments, applications must be relied on to participate in their own protection. There are “best effort” secure coding practices that can be followed to make an application more resistant to malicious subversion.

In commercial environments, the majority of software subversion vulnerabilities result from a few known kinds of coding defects. Common software defects include buffer overflows[1], format string[2] vulnerabilities, integer[3] overflow, and code/command injection. Some common languages such as C and C++ are vulnerable to all of these defects. Other languages, such as Java, are more resistant to some of these defects, but are still prone to code/command injection and other software defects which facilitate subversion. Recently another bad coding practice has come under scrutiny; dangling pointers[4]. The first known exploit for this particular problem was presented in July 2007. Before this publication the problem was known but considered to be academic and not practically exploitable. In summary, "secure coding" can provide significant payback in low security operating environments, and therefore worth the effort. Still there is no known way to provide a reliable degree of subversion resistance with any degree or combination of "secure coding".

Notes:

[1]buffer overflow – переполнение буфера (программная ошибка, которая возникает при отсутствии или недостаточном автоматическом контроле выхода операций записи данных за пределы массива в памяти);

[2]format string – форматирующая строка (строка, используемая в операторах вывода, которая может содержать спецификации форматов, а также литералы);

[3]integer – целое число, встроенный простой тип данных;

[4]dangling pointer – указатель на несуществующий (удаленный) объект; висячий (зависший) указатель.

14. Name the main problem of the text.

15. Make questions to the text to interview your partner abour secure coding.

16. Express your attitude to the facts given in the text. You may use the following phrases:

– It is full of interesting information …
– I find the text rather / very cognitive …
– I've learnt a lot …
– I don't agree with …

17. Give your point of view on possibility of using presented in the text information in your future profession.

Part C

18. Read the title of the text and say what information is presented in it.

19. Read the title of the text and express your point of view on its main idea.

Hardware Mechanisms that Protect Computers and Data

Hardware based or assisted computer security offers an alternative to software-only computer security. Devices such as dongles may be considered more secure due to the physical access required in order to be compromised.

While many software based security solutions encrypt the data to prevent data from being stolen, a malicious program or a hacker may corrupt the data in order to make it unrecoverable or unusable. Similarly, encrypted operating systems can be corrupted by a malicious program or a hacker, making the system unusable. Hardware-based security solutions can prevent read and write access to data and hence offers very strong protection against tampering and unauthorized access.

Working of hardware based security: A hardware device allows a user to login, logout and to set different privilege levels by doing manual actions. The device uses biometric technology to prevent malicious users from logging in, logging out, and changing privilege levels. The current state of a user of the device is read both by a computer and controllers in peripheral devices such as hard disks. Illegal access by a malicious user or a malicious program is interrupted based on the current state of a user by hard disk and DVD controllers making illegal access to data impossible. Hardware based access control is more secure than logging in and logging out using operating systems as operating systems are vulnerable to malicious attacks. Since software cannot manipulate the user privilege levels, it is impossible for a hacker or a malicious program to gain access to secure data protected by hardware or perform unauthorized privileged operations. The hardware protects the operating system image and file system privileges from being tampered. Therefore, a completely secure system can be created using a combination of hardware based security and secure system administration policies.

20. *Find the following information in the text*:
    a) how hardware based security works;
    b) when a hacker can't gain access to secure data.

21. *Prove the following point of view*:
    hardware mechanisms can protect computers and data.

22. *Speak on one of the following points to your partner*:
    a) what you usually do to protect your computer system from malicious users;
    b) what advice you can give to your friend to make his computer system secure.

UNIT VI

CRYPTOGRAPHY

Word List

application	/ "xplI'keISqn //	применение, использование
arbitrarily	/ "RbI'tre(q)r(q)lI /	произвольно
authentication	/ O:"TentI'keISqn //	удостоверение, засвидетельствование подлинности, установление соответствия оригиналу

block cipher	/ blPk 'salfq /	блочный шифр
cheating	/ 'tSJtlN /	нарушение, обман, мошенничество
cipher	/ 'salfq //	код, шифр, тайнопись
confidentiality	/ "kOnfIden(t)SI'xlqti /	конфиденциальность, секретность (информации)
cryptography	/ krlp'tPgrqfi /	криптография
deprecation	/ "deprl'kelSqn //	неодобрение, возражение, протест
designate	/ 'dezlgnelt //	объявлять, называть (что-либо чем-либо)
develop	/ dl'velqp //	развивать, совершенствовать; разрабатывать, проектировать
embodiment	/ lm'bPdlmqnt /	воплощение, осуществление
encryption	/ ln'krlpS(q)n /	шифрование, зашифровывание, кодировка
hash	/ hxS /	беспорядок, мешанина, путаница
hash function	/ hxS 'fAnkS(q)n /	хэш-функция, функция расстановки
integrity	/ ln'tegrlti /	целостность, сохранность, непротиво-речивость и правильность данных
internal	/ ln'tq:n(q)l /	внутренний
knit	/ nlt /	соединять, объединять
malicious	/ mq'llSqs /	злобный, злой, злоумышленный, злонамеренный
onetime	/ 'wAntalm /	бывший, прошедший, прошлый
operate	/ 'Ppqrelt /	работать, действовать
pad	/ pxd /	блокнот, клавиатура, прокладка
privacy	/ 'pralvqsl /	личное дело, тайна, секретность, конфиденциальность; право на частную жизнь; защита персональной информации
relate	/ rl'lelt /	относиться, иметь отношение, затрагивать; быть связанным
repudiation	/ rl"pju:dl'elSqn /	отказ от факта получения или отправления сообщения
require	/ rl'kwalq /	требовать, нуждаться
share	/ SFq //	делиться, разделять, совместно использовать
signature	/ 'slgnltSq //	подпись
stream cipher	/ strJm 'salfq /	поточный шифр, потоковый шифр
successive	/ sqk'seslv /	следующий один за другим, последовательный, последующий
symmetric-key cryptography	/ sl'metrlk 'ki: /	шифрование с использованием симметричного криптографического ключа

Part A

1. Define the following words as parts of speech and give the initial words of the following derivatives.

Encryption, easily, sender, application, embodiment, longer, successive, developed, security, carefully, deprecation, hidden, initially, signature, attacker, broken, receiver, different, arbitrarily.

2. Give Russian words with similar roots.

Cryptography, symmetric, method, publicly, polyalphabetic, aspect, standard, design, finally, variant, popular, block, variation, type, combine, text, secret, material, function.

3. Translate the following words paying attention to the suffixes and prefixes.

Commonly, operation, designation, especial, variant, privacy, widely, signature, knitting, longer, computable, receiver.

4. Fill in the gaps with the words derived from the words in brackets.

1. Symmetric-key cryptography was the only kind of encryption publicly (*know*) until June 1976.
2. The modern study of symmetric-key ciphers (*relation*) mainly to their application.
3. Messages are almost always (*long*) than a single block.
4. A method of (*knit*) together successive blocks is required.
5. Several methods have been developed, some with better (*secure*) in one aspect or another one.
6. The modes of operation must be (*careful*) considered when using a block cipher in a cryptosystem.

5. Fill in the gaps with one of the following words: **operates, popular, as, using, considerable, is combined**.

1. The Data Encryption Standard remains quite … and used in different applications.
2. Many block ciphers have been designed and released, with … variation in quality.
3. Stream ciphers create a long stream of key material which … with the plaintext.
4. A hidden internal state in a stream cipher changes as the cipher … .
5. … the secret key material, that internal state is initially set up.
6. Block ciphers can be used … stream ciphers.

6. Read the text and name key points raised in it.

Symmetric Key Algorithm

Symmetric-key cryptography refers to encryption methods in which both the sender and receiver share the same key (or, less commonly, in which their keys are different, but related in an easily computable way). This was the only kind of encryption publicly known until June 1976.

The modern study of symmetric-key ciphers relates mainly to the study of block ciphers and stream ciphers and to their applications. A block cipher is, in a sense, a modern embodiment of Alberti's polyalphabetic cipher: block ciphers take as input a block of plaintext and a key, and output a block of ciphertext of the same size. Since messages are almost always longer than a single block, some method of knitting together successive blocks is required. Several have been developed, some with better security in one aspect or another than others. They are the modes of operation and must be carefully considered when using a block cipher in a cryptosystem.

The Data Encryption Standard (DES[1]) and the Advanced Encryption Standard (AES[2]) are block cipher designs which have been designated cryptography standards by the US government (though DES's designation was finally withdrawn after the AES was adopted). Despite its deprecation as an official standard, DES (especially its still-approved and much more secure triple-DES variant) remains quite popular; it is used across a wide range of applications, from ATM[3] encryption to e-mail privacy and secure remote access. Many other block ciphers have been designed and released, with considerable variation in quality. Many have been thoroughly broken.

Stream ciphers, in contrast to the "block" type, create an arbitrarily long stream of key material, which is combined with the plaintext bit-by-bit or character-by-character, somewhat like the one-time pad. In a stream cipher, the output stream is created based on a hidden internal state which changes as the cipher operates. That internal state is initially set up using the secret key material. RC4[4] is a widely used stream ciphe. Block ciphers can be used as stream ciphers.

Cryptographic hash functions are a third type of cryptographic algorithm. They take a message of any length as input, and output a short, fixed length hash which can be used in (for example) a digital signature. For good hash functions, an attacker cannot find two messages that produce the same hash. MD4[5] is a long-used hash function which is now broken; MD5, a strengthened variant of MD4, is also widely used but broken in practice.

Notes:

[1]DES – Data Encryption Standard – стандарт шифрования данных;

[2]AES – Advanced Encryption Standard – улучшенный стандарт шифрования, стандарт AES;

[3]ATM – Automatic Teller Machine – банкомат;

[4]RC4 – Rivest cipher 4 – (потоковый, поточный) шифр Райвеста 4, (потоковый шифр с ключом переменного размера, его алгоритм базируется на использовании случайных перестановок. Шифр может надежно служить для безопасной (защищенной) связи и обмена секретными данными);

[5]MD – Message Digest – алгоритм MD (серия алгоритмов (MD2, MD4, MD5) разработана Р. Райвестом для приложений, использующих цифровую подпись. MD4 используется в системе безопасности Windows NT, чтобы из

битовой последовательности произвольной длины получить уникальную битовую последовательность конечной длины).

7. Read the following statements and say whether they are true or false. Correct the false ones.

1. Symmetric-key cryptography refers to the encryption methods in which the sender and receiver share either different keys or the same key.
2. A block of plaintext and a key are output for block ciphers.
3. Some methods of connecting together successive blocks have been developed longer because messages are usually shorter than a single block.
4. Some method of separating successive blocks is necessary in block ciphers.
5. When using a block cipher, there's no need to take into account the modes of operation.
6. Symmetric-key cryptography was a single type of encryption that was popular before 1976.

8. Match parts A and B to complete the sentences.

A	B
1. The US government adopted Data Encryption Standard and Advanced Encryption Standard as … 2. One of popular standards is Data Encryption Standard that … 3. Different block ciphers have been developed, … 4. Combination of a long stream of key material with the plaintext is … 5. A peculiar feature of a stream cipher is … 6. Using the secret key material, … 7. Block ciphers can be used as …	a) is used to ensure e-mail privacy and secure remote access. b) having sufficient qualitative difference. c) cryptography standards. d) typical for stream ciphers. e) stream ciphers. f) changing of a hidden internal state as the cipher operates. g) the internal state is initially set up.

9. Read paragraph 2 and describe the principles of block cipher operation.

10. Using information of paragraph 3 make the description of US cryptography standards.

11. Read paragraph 4 and make description of stream ciphers.

12. Using information of paragraph 5 explain the essence of cryptographic hash functions.

13. Make an outline of the text.

14. Make a short summary of the text in a written form using your outline. The phrases given below will help you.

1. The text deals with … .
2. … are discussed.

3. They include … .
4. It shows … .
5. To sum up … .
6. Intensive efforts have been devoted to … .
7. The efforts continue in the direction of … .

Part B

15. Study the words and word combinations to the following text. Point out the main question of it.

Security, objectives, privacy, data integrity, authentication, non-repudiation.

16. Read the text and write out key words and phrases revealing the contents of the paragraphs.

17. Read the text and find out the topical sentences of the paragraphs.

18. Find 1 or 2 sentences which can be omitted as inessential in each logical part.

19. Look through the text and choose the best title.

1. Cryptographic Secrecy
2. Cryptographic Procedures
3. The Concept of Information
4. Cryptographic Goals

Text B

Of all the information security objectives the following four form a framework upon which the others will be derived: privacy or confidentiality; data integrity; authentication; and non-repudiation.

Confidentiality is a service used to keep the content of information from all but those authorized to have it. Secrecy is a term synonymous with confidentiality and privacy. There are numerous approaches to providing confidentiality, ranging from physical protection to mathematical algorithms which render data unintelligible.

Data integrity is a service which addresses the unauthorized alteration of data. To assure data integrity, one must have the ability to detect data manipulation by unauthorized parties. Data manipulation includes such things as insertion, deletion, and substitution.

Authentication is a service related to identification. This function applies to both entities and information itself. Two parties entering into a communication should identify each other. Information delivered over a channel should be authenticated as to origin, date of origin, data content, time sent, etc. For these content reasons this aspect of cryptography is usually subdivided into two major classes: entity authentication and data origin authentication. Data origin authentication implicitly provides data integrity (for if a message is modified, the source has changed).

Non-repudiation is a service which prevents an entity from denying previous commitments or actions. When disputes arise due to an entity denying that certain actions were taken, a means to resolve the situation is necessary. For example, one entity may authorize the purchase of property by another entity and later deny such authorization was granted. A procedure involving a trusted third party is needed to resolve the dispute.

A fundamental goal of cryptography is to adequately address these four areas in both theory and practice. Cryptography is about the prevention and detection of cheating and other malicious activities.

20. Sum up the text using the key words and word combinations and the topical sentences.

21. Find the sentences containing:

a) the main idea of the text;

b) specifying information.

22. Express your attitude to the facts given in the text. You may use the following phrases:

– It is full of interesting information … .

– I find the text rather/very cognitive … .

– I've learnt a lot … .

– I don't agree with it … .

23. Say which facts presented in the text you ve already been familiar with.

24. Make a questionnaire to the text and interview your partner on the problem raised in the text.

Part C

25. Read the title of text and say what information is presented in it.

26. Scan the following text and say what problems are described in it.

From the History of Cryptography

Cryptography has a long and fascinating history. The most complete non-technical account of the subject is Kahn's The Codebreakers. This book traces cryptography from its initial and limited use by the Egyptians some 4000 years ago, to the twentieth century where it played a crucial role in the outcome of both world wars. Completed in 1963, Kahn's book covers those aspects of the history which were most significant (up to that time) to the development of the subject. The predominant practitioners of the art were those associated with the military, the diplomatic service and government in general. Cryptography was used as a tool to protect national secrets and strategies.

The proliferation of computers and communications systems in 1960s brought with it a demand from the private sector for means to protect information in digital form and to provide security services. Beginning with the work of Feistel at IBM in the early 1970s and culminating in 1977 with the adoption as a U.S. Federal Information Processing Standard for encrypting unclassified information, DES, the

Data Encryption Standard, is the most well-known cryptographic mechanism in history. It remains the standard means for securing electronic commerce for many financial institutions around world.

27. Find the following information in the text:

a) the main fields of cryptography usage;

b) the most common cryptographic mechanism.

28. What can you add to the text using your knowledge in the field of cryptography?

UNIT VII

NEW ELECTRONICS: RESEARCH AND DEVELOPMENT

Word List

achieve	/ q'tSi:v /	достигать
approach	/ q'prqutS /	подход (к рассмотрению, изучению чего-либо)
bulky	/ 'bAlkl /	большой, громоздкий
capable	/ 'kelpqb(q)l /	способный
carbon dioxide	/ "kRbqn dal'Pksald /	двуокись углерода, углекислый газ
cargo	/ 'kQ:gqu /	груз
contamination	/ kqn"txml'nelSqn /	загрязнение, заражение
conventional	/ kqn'venS(q)nl /	традиционный, стандартный
cool	/ ku:l /	студить, охлаждать
crux	/ krAks /	главный, основной, решающий вопрос, основная проблема, затруднение
dangle	/ 'dxNgl /	свободно свисать, качаться, висеть
efficient	/ l'flSqnt /	эффективный, действительный
ferret	/ 'ferlt /	выгонять, разыскивать; сыщик, упорный исследователь
fingerprint(s)	/ 'flNgq"print /	отпечаток пальца, характерный признак
freight	/ frelt /	грузовой, товарный (о транспорте)
fry	/ fral /	жарить
heat	/ hi:t /	теплота
illicit	/ l'llslt /	незаконный, запрещенный
inanimate	/ ln'xnlmlt /	неодушевленный, неживой
melt	/ melt /	таять, плавить, растапливать
overcome	/ "quvq'kAm /	преодолеть
pinpoint	/ 'plnpOlnt /	точно определять, указывать

remote	/ rI'mqut /	отдаленный, дальний
renowned	/ rI'naund /	прославленный, известный, знаменитый
shortcoming	/ SO:t'kAmIN /	недостаток, несовершенство
similarly	/ 'sImIlqlI /	подобным образом, так же
smuggle	/ 'smAgl /	провозить контрабандой, тайно проносить
sniffer	/ 'snIfq /	нюхать, вдыхать носом; наркоман, нюхающий наркотик
spin	/ spIn /	вращение; кружение; верчение
survive	/ sq'vaIv /	пережить, выдержать, продолжить существовать
urgent	/ 'q:dZ(q)nt /	срочный, неотложный, крайне необходимый
variety	/ vq'raIqtI /	разнообразие
voltage	/ 'vqultIdZ /	вольтаж, электрическое напряжение, разность потенциалов

Part A

1. Read the following words in each line and define their roots. Translate the words into Russian:

1) operate, operation, operator, operative;
2) reduction, reductive, reduce;
3) equip, equipment, equipped;
4) develop, developer, development;
5) similar, similarity, similarly.

2. Fill in the gaps with the words derived from the words in brackets.

1. Smuggling is a (*grow*) problem.
2. The screening systems available are typically bulky, expensive and require ultra high (*sensitive*) as the sensor is remote from the cargo.
3. The Ferret will reduce the need for customs and security officials to enter or unpack freight (*contain*).
4. The Ferret is (*equip*) with a suite of sensors that is more sensitive than any currently employed in conventional cargo scanners.
5. UK researchers have made huge advancements in terms of miniaturisation and improving the (*capable*) of the sensors.

3. Find out the equivalents to the following words and word combinations in paragraphs 1 and 2 of the text below.

Разнообразие, системы тщательной проверки, требовать, груз, риск потенциального заражения, крайняя необходимость, альтернативное решение, недостатки, взрывчатые вещества, рентгеновские лучи.

4. Fill in the gaps with one of the following words: **expensive, explosives, overcomes, carbon dioxide, developing, consuming.**

1. UK researchers are … a robot which is able to screen cargo at border controls far more accurately than traditional methods.
2. The process of investigation of the cargo is time … .
3. The screening systems are external, bulky and … .
4. Therefore, there is an urgent need for an alternative solution that … the shortcomings of current techniques of detecting cargoes.
5. Sniffer dogs are trained to search for drugs, … and humans.
6. Tiny traces of … indicate the presence of humans in the container.

5. Read the following text. Choose the sentences covering the main idea of the text.

Ferreting out Contraband

Smuggling – whether goods or people – is a growing problem.

While a variety of technologies is available, the screening systems are external, typically bulky, expensive and require ultra high sensitivity as the sensor is remote from the cargo. Further investigation requires either time consuming unpacking of the cargo or the need for staff to enter the container, putting them at risk of potential contamination. There is, therefore, an urgent need for an alternative solution that overcomes the shortcomings of current techniques of detecting cargoes. X-rays and similar scanners produce images that can often be difficult to interpret – not to mention the dangers of working with radiation. Similarly, sniffer dogs have to be trained to search for a specific item – whether it is drugs, explosives or humans – and they can only work in half hour shifts before they get tired.

The solution is the Cargo Ferret. The device, which will be capable of detecting drugs, weapons and illegal immigrants hidden in cargo containers, is being developed as part of a £732,000 project, which began in October 2008 in the UK.

The three year research project will result in what its developers say is the world’s first screening device able to pinpoint all kinds of illicit substances and the first designed to operate inside standard freight containers.

The Ferret will reduce the need for customs and security officials to enter or unpack freight containers. Suitable for use at seaports and airports, the Ferret is equipped with a suite of sensors that is more comprehensive and more sensitive than any currently employed in conventional cargo scanners.

By combining two different types of sensor – laser and fibre optic based – the Ferret will lead to confidence in detection improving considerably.

The sensors are small enough to be carried on the robot and can detect specific “fingerprints” of illegal substances at much lower concentrations than currently possible. When placed inside a steel freight container, the ferret will attach itself magnetically to the top, then automatically move around searching for contraband, while sending a stream of information back to the controller.

There's a better chance of detection if the sensors are inside a lorry. It improves detection rates and minimises false alarms – which is a huge problem. The act of emptying a lorry and finding nothing wastes a great deal of time.

By focusing on new sensor technologies, Dr Dodd and his team have made huge advancements in terms of miniaturisation and improving the capabilities of the sensors. The sensors developed are targeted to match the sensitivity of dogs in detecting substances problems of distraction, confusion, with a much longer on duty time, due to the sensor's inanimate nature.

The core component of the sensor device, however, is the specific sensor material design, which is required to be able to interact with specific drugs and in the meantime to produce corresponding output signals – for example, fluorescent or spectroscopic signal variations in relation to the presence and the concentration of the drugs present.

Due to the advantageous nature of an optical fibre, both in terms of the wave guiding and of sensing, the sensor device created will be compact, low power and lightweight to be best tailored to use in field.

Fibre optic and laser properties vary greatly, depending on the presence of different items. In many ways, the approach is similar to fingerprinting. The sensors can detect extremely low concentrations of illegal substances and have the ability to locate multiple items. They transmit peak signals which correspond to particular substances.

Human trafficking is the fastest growing criminal industry in the world. Equipped with magnetic wheels, the Ferret can not only attach itself to the ceiling, but can also dangle sensors deep into the container. These can then detect tiny traces of carbon dioxide, which indicate the presence of humans in the container.

UK researchers are designing the Cargo Ferret to be as user friendly as possible, so UK border agents will require only minimal training and the process of detection will be as quick and efficient as possible. The scientists predict that the Ferret will be ready for testing within two years, with potential deployment within five years.

6. Read the following statements and say whether they are true or false. Correct the false ones.

1. Nowadays smuggling is not a problem at all.
2. The screening systems available are typically bulky, high-priced and require ultra high sensitivity.
3. UK researchers are developing a robot which is able to screen cargo at border controls far more accurately than traditional methods.
4. The Ferret will increase the need for customs and security officials to enter or unpack freight containers.
5. The Cargo Ferret is equipped with only one type of sensor – fibre optic based.
6. The sensors can detect extremely low concentrations of illegal substances.
7. The Ferret can't indicate the presence of humans in a container.
8. UK border agents will require thorough training before using the Ferret.

7. Express your attitude to the importance of developing new technologies in the field of border controls.

8. Using the information from the text speak about the advantages of the Cargo Ferret.

9. Make an outline of the text.

10. Make a short summary of the text in written form using your outline.

Part B

11. Look at the title. Make your predictions about the contents of the text.

12. Read the text and write out key words and phrases revealing the contents of the text.

13. Find the paragraphs in the text which describes an alternative way to process information.

Spintronics Technology May Cool the Laptop

Does your laptop sometimes get so hot that it can almost be used to fry eggs? New technology may help cool it and give information technology a unique twist, says Jairo Sinova, a professor of physics from Texas University. Sinova and colleagues from Hitachi Cambridge Laboratory, University of Cambridge and University of Nottingham have had their research published in the renowned journal Nature Physics.

Laptops are getting increasingly powerful, but as their sizes are getting smaller they are heating up, so how to deal with excessive heat becomes a headache. The crux of the problem is the way information is processed. Laptops and some other devices use flows of electric charge to process information, but they also produce heat. Theoretically, excessive heat may melt the laptop. This also wastes a considerable amount of energy. Is there a solution?

One approach may be found in Sinova's research – an alternative way to process information. The research looks at the spin of electrons, tiny particles that naked eyes cannot detect. The directions they spin can be used to record and process information. To process information, it is necessary to create information, transmit the information and read the information. How these are done is the big question. The device the researchers designed injects the electrons with spin pointing in a particular direction according to the information the scientists want to process, and then they transmit the electrons to another place in the device but with the spin still surviving, and finally the researchers are able to measure the spin direction via a voltage that they produce.

The biggest challenge to creating a spin-based device is the distance that the spins will survive in a particular direction. Transmission is no problem. You can think for comparison that if the old devices could only transmit the information to several hundred feet away, with the new device, information can be easily transmitted to hundreds of miles away. It is very efficient.

Talking about its practical application, Sinova is very optimistic. This new device, as the only all-semiconductor spin-based device for possible information processing, has a lot of real practical potential. One huge thing is that it is operational at room temperature, which nobody has been able to achieve until now. It may bring in a new and much more efficient way to process information.

14. Ask questions to the text making an outline of it.

15. Express your attitude to the facts given in the text. You may use the following phrases:

– It is full of interesting information… .
– I find the text rather/ very cognitive… .
– I've learnt a lot… .
– I don't agree with it… .

16. Say which facts presented in the text you've already been familiar with.

17. Give your point of view on the possibility of using the information presented in the text in your future profession.

Part C

18. Look through the following text, define the information presented in it and entitle the text.

Text C

As opposed to traditional electronics, which uses the charge of the electron, spintronics uses the electron's "spin" and manipulates the spin orientation. An electron's sense of rotation is represented by a spin that either points up or down. In magnetic material the spin orientation of the electron can be used to store information to a semiconductor, so that the information stored can be processed in spin-based electronic components.

The use of spintronics technology could revolutionize the electronics and computing industries by making it possible to store vast amounts of data in much smaller devices than is currently possible.

The development of a silicon-based device that works at room temperature is a breakthrough for two reasons: first, silicon is the prevalent material in modern electronics production; and second, until now scientists have only been able to demonstrate control of electron spin at low temperatures that are not everyday use.

The demonstration of information exchange between a magnetic material and a semiconductor at room temperature is a positive step in the development of spintronics technology. If the new technology takes off it would mean huge energy savings because reversing the "electronic spin" would require less power than the normal electronic charge.

19. Say where the information presented in the text can be used.

20. Prove that spintronics could mean big energy savings.

UNIT VIII

INTEGRATED CIRCUITS

Word List

alter	/ 'O:ltq /	изменять, видоизменять, вносить изменения, переделывать
array	/ q'rel /	множество, группа; матрица, сетка, решетка; массив данных
coat	/ kqut /	покрытие; покрывающий слой; облицовка; покрывать; наносить покрытие; облицовывать
deposition	/ "depq'zlSqn /	осаждение, выделение (металла на аноде или катоде при электролизе), выпадение, депонирование, нанесение (покрытий, пленок и т. п.), напыление, отложение
diffuse	/ dl'fju:s /	диффундировать; рассеивать(ся); распылять(ся)
dissolve	/ dl'zPlv /	растворять(ся), разжижать(ся), разлагать(ся) (на составные части)
etch	/ etS /	травить (обрабатывать материал для выявления структуры), протравливать (в металлографии)
expose	/ eks'pquz /	экспонировать; подвергать облучению, облучать; воздействовать, подвергать воздействию
gate	/ gelt /	ключевая схема, вентильная схема, вентиль, генератор селекторных импульсов, задвижка, затвор, ключ
impose	/ lm'pquz /	класть, помещать, фиксировать в определенном положении
impurity	/ lm'pjuqrltl /	примесь; включение
inevitable	/ ln'evltqbl /	неизбежный, неминуемый, неотвратимый
ingot	/ 'lNgqt /	слиток, болванка, чушка; выращенный кристалл
layer	/ 'lelq /	слой, пласт, прослойка, прокладка
masking	/ mQ:sklN /	маскирование, наложение маски, нанесение маскирующего слоя или маскировочного покрытия
opaque	/ q'pelk /	непрозрачный, светонепроницаемый, непросвечивающий
phosphine	/ 'fPsfJn /	фосфин, фосфористый водород
photoresist	/ 'fqutqurl'zlst /	фоторезист (светочувствительный материал, затвердевающий под воздействием светового потока, используется при изготовлении печатных плат)
polish	/ 'pqullS /	полировать, шлифовать
property	/ 'prPpqtl /	свойство, способность; характеристика

reduce	/ rI'dju:s /	восстанавливать, снижать, сокращать, приводить (выражение к виду), сводить, уменьшать(ся)
reject	/ 'ri:dZekt /	отходы; брак; отвергать, отклонять, забраковывать
reliable	/ rI'laIqbl /	надежный, достойный доверия; достоверный
require	/ rI'kwaIq /	требовать (чего-либо); нуждаться (в чем-либо)
solve	/ sPlv /	растворять
spin (spun, spun)	/ spIn /	быстро вращаться; вертеть(ся); крутиться
transfer	/ 'trxnsfq: /	передача, перенос, переход, перемещение; передавать, переносить, переходить, перемещать
ubiquitous	/ ju:'bIkwItqs /	вездесущий; повсеместный
vapor	/ 'veIpq /	пар; испарять(ся)
versatile	/ 'vq:sqtaIl /	универсальный, широкого назначения; эксплуатационно гибкий, переналаживаемый

Part A

1. Translate the following words which may have some similarity with the words in Russian but often differ in meaning.

Integration, component, diffusion, silicon, principal, miniature, demonstrate, control, application, scale, technique, chip, production, commercial, initiate, communication, manufacture, filter, typical, process, oxygen, solvent, mask, accurate, implant, deposit, separate, precision.

2. Read the following words in each line and define their part of speech. Translate the words into Russian:

1) integrate, integration, integrator;
2) process, processor, procession;
3) produce, production, producer, productive, product;
4) solve, solution, solvent, soluble, insoluble;
5) apply, application, applicable, appliance;
6) dope, dopant, doping;
7) control, controller, controllable;
8) identify, identity, identification;
9) separate, separation, separable;
10) react, reaction, reactive, reactor;
11) vapor, vaporize, vaporization;
12) ion, ionize, ionization;
13) oxide, oxidation, oxidizer;
14) pure, purify, purification, purity, impurity.

3. Match the following terms with their definitions.

1) clean room	a) a light-sensitive coating that is applied to a substrate or board, exposed, and developed prior to chemical etching; the exposed areas serve as a mask for selective etching
2) ingot	b) a substance, e.g. boron or phosphorous added in small amounts to a pure semiconductor material to alter its conductive properties for use in transistors and diodes
3) photoresist	c) a room that is maintained virtually free of contaminants, such as dust or bacteria, used in laboratory work and in the production of precision parts for electronic or aerospace equipment
4) dopant	d) a material, usually metal, that is cast into a shape suitable for further processing. Non-metallic and semiconductor materials prepared in bulk form may also be referred to as ingots, particularly when cast by mold based methods
5) diffusion	e) a small thin circular slice of a semiconducting material, such as pure silicon, on which an integrated circuit can be formed. It serves as the substrate for microelectronic devices built in and over it and undergoes many microfabrication process steps such as doping or ion implantation, etching, deposition of various materials, and photolithographic patterning
6) plazma etching	f) a process that utilizes accelerated ions to penetrate a solid surface. The implanted ions can be used to modify the surface composition, structure, or property of the solid material
7) deposition	g) the transport of matter from one point to another by random molecular motions. It occurs in gases, liquids, and solids
8) wafer	h) a process in which gas transforms into solid
9) ion implantation	i) a form of processing used to fabricate integrated circuits. It involves a high-speed stream of glow discharge (plasma) of an appropriate gas mixture being shot (in pulses) at a sample. The plasma source, known as etch species, can be either charged (ions) or neutral (atoms and radicals). During the process, the plasma will generate volatile etch products at room temperature from the chemical reactions between the elements of the material etched and the reactive species generated by the plasma

4. Translate the following sentences paying attention to the words in bold type.

1. The mask is removed and portions of the photoresist **are dissolved.**

2. The uncovered areas are then either chemically **etched** to open up a layer or are subjected to chemical **doping** to create a layer of P or N regions.

3. The dopant **is deposited** on the hot surfaces left exposed by the masking process.

4. This is done through a process known as **chemical vapor deposition**.

5. A thin, round **wafer** of silicon is cut off the ingot using a precise cutting machine called a wafer slicer.

6. A drop of photoresist material is placed in the center of the silicon wafer, and the wafer **is spun** rapidly to distribute the photoresist over the entire surface.

7. The ions **penetrate** the wafer and remain **implanted**.

8. The process of masking and etching or doping **is repeated** for each successive layer depending on the doping process used until all of the integrated circuit chips are complete.

9. The hundreds of individual chips **are separated** with a fine diamond cutter.

10. The completed integrated circuits **are sealed** in anti-static plastic bags to be stored or shipped to the end user.

5. Complete the following sentences filling in one of the words given below: **incorporated, design, technologies, invention, printed circuit boards, inexpensive, bipolar junction transistor, reliability, advantages, contained, doping.**

1. The first integrated circuits … only up to a dozen components.
2. Bipolar integrated circuits are the circuits in which the principal element is the … .
3. Several major types of MOS device fabrication … have been developed since the mid-1960s.
4. These miniature circuits have demonstrated low cost, high … , low power requirements, and high processing speeds compared to the vacuum tubes and transistors which preceded them.
5. After the … of the IC in 1959, the number of components and circuits that could be … into a single chip doubled every year for several years.
6. The complex and interconnected design of the circuits and components is prepared in a process similar to that used to make … .
7. Integrated circuit microcomputers are so … they are even found in children's electronic toys.
8. The uncovered areas are then either chemically etched to open up a layer or are subjected to chemical … to create a layer of P or N regions.
9. The … of each layer is prepared on a computer-aided drafting machine.
10. They allowed more complex systems to be produced using smaller circuit boards, less assembly work (because of fewer separate components), and a number of other … .

6. Read the text and arrange the following items of outline in accordance with the text.

1. Rapid growth of ICs' complexity.
2. The importance of ICs in our life.
3. Micropressor chips and their development.
4. Invention of the IC.
5. What is an IC?

Integrated Circuits

An integrated circuit, commonly referred to as IC, is a microscopic array of electronic circuits and components that has been diffused or implanted onto the surface of a single crystal, or chip, of semiconducting material such as silicon. It is called an integrated circuit because the components, circuits, and base material are all made together, or integrated, out of a single piece of silicon, as opposed to a discrete circuit in which the components are made separately from different materials and assembled later. ICs range in complexity from simple logic modules and amplifiers to complete microcomputers containing millions of elements.

The first integrated circuits were created in the late 1950s in response to a demand from the military for miniaturized electronics to be used in missile control systems. At the time, transistors and printed circuit boards were the state-of-the-art electronic technology. Although transistors made many new electronic applications possible, engineers were still unable to make a small enough package for the large number of components and circuits required in complex devices like sophisticated control systems and handheld programmable calculators. Several companies were in competition to produce a breakthrough in miniaturized electronics, and their development efforts were so close that there is some question as to which company actually produced the first IC. In fact, when the integrated circuit was finally patented in 1959, the patent was awarded jointly to two individuals working separately at two different companies.

After the invention of the IC in 1959, the number of components and circuits that could be incorporated into a single chip doubled every year for several years. The first integrated circuits contained only up to a dozen components. The process that produced these early ICs was known as small scale integration, or SSI. By the mid-1960s, medium scale integration, MSI, produced ICs with hundreds of components. This was followed by large scale integration techniques, or LSI, which produced ICs with thousands of components and made the first microcomputers possible.

The first microcomputer chip, often called a microprocessor, was developed by Intel Corporation in 1969. It went into commercial production in 1971 as the Intel 4004. Intel introduced their 8088 chip in 1979, followed by the Intel 80286, 80386, and 80486. In the late 1980s and early 1990s, the designations 286, 386, and 486 were well known to computer users as reflecting increasing levels of computing power and speed. Intel's Pentium chip is the latest in this series and reflects an even higher level.

Only a half century after their development was initiated, integrated circuits have become ubiquitous. Computers, cellular phones, and other digital appliances are now inextricable parts of the structure of modern society. That is, modern computing, communications, manufacturing and transport systems, including the Internet, all depend on the existence of integrated circuits.

The impact of integrated circuits on our lives has been enormous. ICs have become the principal components of almost all electronic devices. These miniature circuits have demonstrated low cost, high reliability, low power requirements, and high processing speeds compared to the vacuum tubes and transistors which preceded them. Integrated circuit microcomputers are now used as controllers in equipment such as machine tools, vehicle operating systems, and other applications where hydraulic, pneumatic, or mechanical controls were previously used. Because IC microcomputers are smaller and more versatile than previous control mechanisms, they allow the equipment to respond to a wider range of input and produce a wider range of output. They can also be reprogrammed without having to redesign the control circuitry. Integrated circuit microcomputers are so inexpensive they are even found in children's electronic toys.

7. Match the letter of the correct answer to the following questions.

1. What is an integrated circuit?

   a) It is a circuit consisting of a great number of components mounted one after another on a silicon wafer.

   b) It is a circuit consisting of a number of vacuum tubes and transistors placed on chip.

   c) It is a circuit containing a great number of components made of semiconductor materials diffused or implanted on the surface of a silicon wafer.

2. What kind of impact did ICs produce on our life?

   a) They are of no importance.

   b) Their invention caused rapid increase in the performance of electronic equipment.

   c) They did not allow the equipment to respond to a wider range of input and produce wider range of output.

3. What are the advantages of ICs in comparison with the vacuum tubes?

   a) They are cheap, reliable, consume much power and are characterized by lower processing speed.

   b) They are reliable, cheaper, consume less power and handle more information than vacuum tubes.

   c) In spite of their better cost, reliability and power characteristics ICs are very fragile.

4. What was the invention of the IC instigated by?

   a) The first integrated circuit appeared in the result of efforts to meet the requirement of the military sphere for electronics designed for missile control systems.

   b) They were needed because sophisticated control systems and handheld programmable calculators contained smaller number of components and were less complex.

   c) Transistors and printed circuit boards were too small to be used in the electronics for missile control systems.

5. What was the rate of the IC's complexity increase in the years that followed its invention?

   a) It became three times higher.

   b) It remained unchanged for a very long period of time.

c) It became two times more complex with every coming year.

6. What kind of ICs made microcomputers possible?
   a) SSI ICs;
   b) MSI ICs;
   c) LSI ICs.

7. What did Intel 80286, 80386 and 80486 differ in?
   a) They differed in the architecture.
   b) There was no difference between them.
   c) Each successive type had higher computing power and speed thanks to the higher power of its processor.

8. Read the following sentences and say which of them are true or false.

1. Integrated circuit is a circuit consisting of a few discrete transistors placed on wafer.
2. All the components of the integrated circuits are assembled one by one.
3. The first integrated circuit appeared in the result of efforts to provide electronic devices for sophisticated missile control systems.
4. The inventors of the integrated circuit worked at the same company.
5. For several decades after the IC invention, the number of components on a single chip remained unchanged.
6. MSI circuits were followed by LSI circuits consisting of hundreds of components.
7. The first microprocessor appeared in 1971.
8. Intel 286, 386 and 486 did not differ in their power and speed.
9. Integrated circuits have become indispensable in modern equipment.

9. Pick up the information from the text that might be of use to speak about the evolution of integrated circuits. Find additional information in the WWW.

Part B

10. Look through the text and suggest your own title.

11. The text is divided into several parts. Look through the text and arrange the titles of the parts in accordance with the text.

1. Silicon wafer preparation.
2. Cutting the wafer into chips.
3. Doping.
4. Masking.
5. Making successive layers.
6. IC manufacturing is a complicated process requiring specific conditions.
7. Packaging and marking.
8. Packing.

The IC Manufacturing Process

1. Hundreds of integrated circuits are made at the same time on a single, thin slice of silicon and are then cut apart into individual IC chips. The manufacturing process takes place in a tightly controlled environment known as a clean room where the air is filtered to remove foreign particles. The few equipment operators in the room wear lint-free garments, gloves, and coverings for their heads and feet. Since some IC components are sensitive to certain frequencies of light, even the light sources are filtered. Although manufacturing processes may vary depending on the integrated circuit being made, the following process is typical.

2. The actual IC manufacturing is preceded by the stage of preparing the silicon waver. The procedure includes the conversion of silicon into monocrystal form and creation of monocrystalline silicon ingot. Then, a thin, round wafer of silicon is cut off the ingot using a precise cutting machine called a wafer slicer. Each slice is about 0.01 to 0.025 inches (0.004 to 0.01 cm) thick. The surface on which the integrated circuits are to be formed is polished. Once the wafer is formed and processed the actual IC manufacturing begins.

3. It starts with the oxide film coating of the wafer. The surfaces of the wafer are coated with a layer of silicon dioxide to form an insulating base and to prevent any oxidation of the silicon which would cause impurities. The silicon dioxide is formed by subjecting the wafer to superheated steam at about 1000 °C under several atmospheres of pressure to allow the oxygen in the water vapor to react with the silicon. Controlling the temperature and length of exposure controls the thickness of the silicon dioxide layer.

4. The complex and interconnected design of the circuits and components is prepared in a process similar to that used to make printed circuit boards. For ICs, however, the dimensions are much smaller and there are many layers superimposed on top of each other. The design of each layer is prepared on a computer-aided drafting machine, and the image is made into a mask which will be optically reduced and transferred to the surface of the wafer. The mask is opaque in certain areas and clear in others. It has the images for all of the several hundred integrated circuits to be formed on the wafer.

A drop of photoresist material is placed in the center of the silicon wafer, and the wafer is spun rapidly to distribute the photoresist over the entire surface. The photoresist is then baked to remove the solvent.

The coated wafer is then placed under the first layer mask and irradiated with light. Because the spaces between circuits and components are so small, ultraviolet light with a very short wavelength is used to squeeze through the tiny clear areas on the mask. Beams of electrons or x-rays are also sometimes used to irradiate the photoresist.

The mask is removed and portions of the photoresist are dissolved. If a positive photoresist was used, then the areas that were irradiated will be dissolved. If a negative photoresist was used, then the areas that were irradiated will remain. The uncovered areas are then either chemically etched to open up a layer or are subjected to chemical doping to create a layer of P or N regions.

5. One method of adding dopants to create a layer of P or N regions is atomic diffusion. In this method a batch of wafers is placed in an oven made of a quartz tube surrounded by a heating element. The wafers are heated to an operating temperature of about 1500–2200°F (816–1205°C), and the dopant chemical is carried in on an inert gas. As the dopant and gas pass over the wafers, the dopant is deposited on the hot surfaces left exposed by the masking process. This method is good for doping relatively large areas, but is not accurate for smaller areas. There are also some problems with the repeated use of high temperatures as successive layers are added.

The second method to add dopants is ion implantation. In this method a dopant gas, like phosphine or boron trichloride, is ionized to provide a beam of high-energy dopant ions which are fired at specific regions of the wafer. The ions penetrate the wafer and remain implanted. The depth of penetration can be controlled by altering the beam energy, and the amount of dopant can be controlled by altering the beam current and time of exposure. Schematically, the whole process resembles firing a beam in a bent cathode-ray tube. This method is so precise, it does not require masking – it just points and shoots the dopant where it is needed. However it is much slower than the atomic diffusion process.

6. The process of masking and etching or doping is repeated for each successive layer depending on the doping process used until all of the integrated circuit chips are complete. Sometimes a layer of silicon dioxide is laid down to provide an insulator between layers or components. This is done through a process known as chemical vapor deposition, in which the wafer's surface is heated to about 752 °F (400 °C), and a reaction between the gases silane and oxygen deposits a layer of silicon dioxide. A final silicon dioxide layer seals the surface, a final etching opens up contact points, and a layer of aluminum is deposited to make the contact pads. At this point, the individual ICs are tested for electrical function.

7. The thin wafer is like a piece of glass. The hundreds of individual chips are separated with a fine diamond cutter and then putting the wafer under stress to cause each chip to separate. Those ICs that failed the electrical test are discarded. Inspection under a microscope reveals other ICs that were damaged by the separation process, and these are also discarded.

8. The good ICs are individually bonded into their mounting package and the thin wire leads are connected by either ultrasonic bonding or thermocompression. The mounting package is marked with identifying part numbers and other information.

The completed integrated circuits are sealed in anti-static plastic bags to be stored or shipped to the end user.

12. Read attentively part 4 and say what operations masking is connected with.

13. Read part 5 and say what methods of doping are described in it. Say what weak points of each method of doping are mentioned.

14. What kind of process is used to provide an insulator between layers or components?

15. Say whether it is right to state that ICs are qualified as good or to be discarded only by microscope inspection.

16. Make your own block diagram of the IC manufacturing process and be ready to give details concerning some of the stages (e.g. photoresist coating, masking, doping).

Part C

17. Look through the following text and title it.

Text C

Depending on the type of transistors, the integrated circuits are based on they can be classified into bipolar, MOS[1] and BiCMOS[2] integrated circuits.

Bipolar integrated circuits are the circuits in which the principal element is the bipolar junction transistor. They are generally used where the highest logic speed is desired.

The other major class of integrated circuits is called MOS because its principal device is a metal oxide semiconductor field-effect transistor (MOSFET[3]). It is more suitable for very large-scale integration (VLS[4]) than bipolar circuits because MOS transistors are self-isolating and can have an average size of less than 10^{-7} in.$^{-2}$ (10^{-5} mm^2). This has made it practical to use millions of transistors per circuit. Because of this high-density capability, MOS transistors are used for high-density random-access memories (RAMs[5]), read-only memories (ROMs[6]), and microprocessors.

Several major types of MOS device fabrication technologies have been developed since the mid-1960s. They are: (1) metal-gate *p*-channel MOS (PMOS[7]), which uses aluminum for electrodes and interconnections; (2) silicon-gate *p*-channel MOS, employing polycrystalline silicon for gate electrodes and the first interconnection layer; (3) *n*-channel MOS (NMOS), which is usually silicon gate; and (4) complementary MOS (CMOS[8]), which employs both *p*-channel and *n*-channel devices.

Both conceptually and structurally the MOS transistor is a much simpler device than the bipolar transistor. In fact, its principle of operation has been known since the late 1930s, and the research effort that led to the discovery of the bipolar transistor was originally aimed at developing the MOS transistor. What kept this simple device from commercial utilization until 1964 is the fact that it depends on the properties of the semiconductor surface for its operation, while the bipolar transistor depends principally on the bulk properties of the semiconductor crystal. Hence MOS transistors became practical only when understanding and control of the properties of the oxidized silicon surface had been perfected to a very great degree

There is a strong interest in combining high-performance bipolar transistors and high-density CMOS transistors on the same chip (BiCMOS). This concept originated with work on bipolar circuits when power limitations became important as more functionality (and thus more transistors) was added to the chip. It is possible to continue adding more circuits on a chip without increasing the power by combining the low-power CMOS circuits with the bipolar circuits. This is done with both memory circuits and logic circuits, resulting in speeds somewhere between those of typical CMOS and bipolar-only circuits, but with the functional density of CMOS. The disadvantage of BiCMOS is its additional cost over plain CMOS or bipolar circuits, because the number of processing steps increases 20–30 %. However, this increased complexity is expected to be used when either the additional functionality over bipolar circuits or the increased speed over CMOS circuits justifies the cost.

Notes:

[1]MOS – metal-oxide-semiconductor – металл-окисел-полупроводник, МОП-технология (структура);

[2]BiCMOS – bipolar complementary metal-oxide-semiconductor – (запоминающая) биполярная КМОП-структура; биполярная КМОП-технология, БиКМОП технологический процесс изготовления полупроводниковых устройств;

[3]MOSFET – metal-oxide-semiconductor field-effect transistor – полевой транзистор с МОП-структурой;

[4]VLSI – Very Large-Scale Integration – сверхбольшая степень интеграции, сверхбольшая интегральная микросхема, СБИС;

[5]RAM – random-access memory – запоминающее устройство с произвольной выборкой, оперативное запоминающее устройство;

[6]ROM – read-only memory – постоянное запоминающее устройство;

[7]PMOS – p-channel metal-oxide-semiconductor – МОП-структура с каналом p-типа, p-канальная МОП-структура, p-МОП-структура;

[8]CMOS – complementary metal-oxide semiconductor, complementary MOS – комплементарная структура.

18. Sum up the information about the MOS transistors.

19. Speak about CMOS and BiCMOS circuits, their advantages and disadvantages.

UNIT IX

SEMICONDUCTORS

Word List

conductivity	/ "kPndAk'tIvItI /	удельная проводимость; электропроводность
charge carrier	/ tSQ:dZ 'kxrIq /	носитель заряда
crystal lattice	/ 'krIstl 'lxtIs /	кристаллическая решетка
current density	/ 'kArqnt 'densItI /	плотность тока
diversified	/ daI'vq:sIfaId /	многосторонний, различный, разнообразный
dopant	/ 'dqupqnt /	легирующая примесь

doping	/ 'dqupIN /	легирование
enhance	/ In'hQ:ns /	увеличивать, усиливать
extrinsic	/ eks'trInsIk /	примесный
fanciful	/ 'fxnsIful /	невообразимый, нереальный
fluctuation	/ "flAktju'eISqn /	колебание, отклонение
fragile	/ 'frxdZaIl /	хрупкий
frequency	/ 'fri:kwqnsI /	частота
intrinsic	/ In'trInsIk /	присущий, собственный
majority carrier	/ mq'dZPrItI 'kxrIq /	основной носитель (заряда)
minority carrier	/ maI'nPrItI 'kxrIq /	неосновной носитель (заряда)
power consumption	/ 'pauq kqn'sAmpSqn /	потребление энергии
purify	/ 'pjuqrIfaI /	очищать
replacement	/ rI'pleIsmqnt /	замена
source	/ sO:s /	источник
take advantage of sth.	/ qd'vQ:ntIdZ /	воспользоваться чем-либо
thermionic emitter	/ "TWmI'PnIk I'mItq /	термоэлектронный эмиттер
travelling wave tube	/ 'trxvlIN 'weIv 'tju:b /	лампа бегущей волны
vacuum tube	/ 'vxkjuqm 'tju:b /	электронная лампа
valve	/ vxlv /	электронная лампа, электровакуумный прибор
versatile	/ 'vq:sqtaIl /	многосторонний, многоцелевой, универсальный

Part A

1. Make up English-Russian pairs of the words and word-combinations equivalent in meaning.

1) demand	a) удовлетворять требования
2) investigation	b) электронная лампа
3) seek	c) побуждать, поощрять
4) ultimately	d) исследование
5) satisfy the needs	e) в конце концов, окончательно
6) evolving	f) хрупкий
7) foment	g) потребность, спрос
8) fanciful	h) искать
9) vacuum tube	i) общеизвестно
10) fragile	j) ненасытный, неутолимый
11) versatile	k) развивающийся
12) notoriously	l) невообразимый, нереальный
13) insatiable	m) универсальный

2. Define the following words as parts of speech and give the initial words of the following derivatives.

Conductivity, insulators, investigation, replacement, inexpensive, manufacturer, application, purifying, improvement, impressive, valuable, unrealible.

3. Fill in the gaps with the words derived from the words in brackets.

1. The rapid growth of the national telephone network had made the … (*replace*) of mechanical switches highly desirable.
2. It was … (*expensive*) portable radios that created the first large … (*commerce*) market for the device.
3. American researchers and … (*manufacture*) sought the ways to use germanium-based transistors in computing machines.
4. … (*improve*) in semiconductor devices led to faster, cheaper electronics of all kinds.
5. The new tecnology proved to be far more than an … (*increment*) improvement.
6. Silicon has earned a most … (*value*) place in the history of technology and twentieth-century culture.

4. Read the following words in each line and define their roots. Translate the words into Russian:

1) determined, determination, determinative, determinedly, determiner;
2) improvement, improvable, improving, improved, improver;
3) conductor, conductivity, conduction, conductance, conducting;
4) manufacture, manufacturer, manufacturing, manufacturability;
5) incremental, incrementally, incrementor, incrementation;
6) evolving, evolvement, evolution, evolved, evolutionary, evolutional;
7) reliable, unreliable, reliability, reliableness, reliably.

5. Read the following text and name the key points raised in it.

Semiconductors

Semiconductors are solid materials with a level of electrical conductivity between that of insulators and conductors. Although the scientific study of semiconductors began in the nineteenth century, concentrated investigation of their use did not begin until the 1930s. The development of quantum physics during the first third of the twentieth century gave scientists the theoretical tools necessary to understand the behavior of atoms in solids, including semiconductors. But it was a commercial need that really stimulated semiconductor research in the United States. The rapid growth of the national telephone network had by 1930 made the replacement of mechanical switches highly desirable. Vacuum tubes, used in radios and other devices, were too expensive and fragile for use in the telephone network, so researchers turned their focus to solid crystals. Germanium and silicon showed the most promise. Scientists at Bell Laboratories designed the first transistor using the semiconductor germanium. A prototype was produced in 1947, and innovation followed rapidly.

Transistors replaced vacuum tubes in electronic devices slowly at first. It was inexpensive portable radios that created the first large commercial market for the device. American researchers and manufacturers sought ways to use germanium-based transistors in computing machines. The more versatile silicon, however, ultimately replaced germanium to satisfy the needs of evolving computer technology.

The semiconductor silicon gave its name to a region – an area between San Jose and San Francisco, California, that became known as Silicon Valley – and fomented revolutions in technology, business, and culture. Once scientists had determined that silicon had the necessary properties for applications in computing, practical concerns took center stage. Although silicon is one of the most common elements on earth - sand is made of silicon and oxygen – isolating and purifying it is notoriously difficult. But interest in silicon-based devices was very strong, and by the late 1950s a diversified semiconductor industry was developing, centered in California but serving government and commercial clients throughout the country.

The electronics industry initially turned to semiconducting materials to replace large, slow, electromechanical switches and fragile, unreliable vacuum tubes. But the new technology proved to be far more than an incremental improvement. Semiconductors showed promise for miniaturization and acceleration that previously seemed fanciful. An insatiable desire for faster, smaller devices became the driving force for the semiconductor industry. An impressive stream of innovations in theory, design, and manufacturing led the semiconductor industry to make ever-smaller, ever-faster devices for the next half century. Improvements in semiconductor devices led to faster, cheaper electronics of all kinds, and to the spread of the semiconductor and its dependent industries throughout the world.

The future will likely bring a replacement for silicon in the ongoing search for smaller, faster electronic devices, but silicon has earned a most valuable place in the history of technology and twentieth-century culture.

6. *Read paragraph 1 of the text and answer the questions*:

1. What are semiconductors?
2. What gave scientists the theoretical tools to understand the behaviour of atoms in semiconductors?
3. Why do scientists turn their focus to solid crystals?

7. *Read paragraph 3 and explain why there was such a big interest in silicon.*

8. *Choose the correct answer to the following questions*:

1. Vacuum tubes used in radios and other devices were …
   a) too costly and fragile;
   b) expensive but promising;
   c) too cheap and unreliable.
2. Semiconductor research in the USA was stimulated by …
   a) the government order;
   b) stiff competition among private companies;
   c) a commercial need.

3. Scientists had determined that silicon had the necessary properties for applications in …

a) electromechanical switches;

b) computing;

c) inexpensive radios.

4. Semiconductors showed promise for making devices …

a) smaller and faster;

b) smaller and more expensive;

c) bulky but cheaper.

5. The first large commercial market for transistors was created by …

a) mechnical switches;

b) vacuum tubes;

c) cheap portable radios.

9. Read the following statements and say whether they are true or false. Correct the false ones.

1. The concentrated investigation of the use of semiconductors began only in the 1930s.
2. Semiconductor germanium was used in the designing of the first transistor.
3. Vacuum tubes were quickly replaced by transistors in electonic devices.
4. Silicon is difficult to isolate and purify.
5. It was germanium that satisfied the needs of evolving computer technology.
6. Semiconductors turned out to be promising for miniaturization and acceleration.

10. Match the parts to complete the sentences.

1. The semiconductor silicon gave its name to a region …	a) to replace electromechanical switches and vacuum tubes.
2. Vacuum tubes were too expensive and fragile …	b) the spread of the semiconductor industries throughout the world.
3. By the late 1950s a diversified semiconductor industry …	c) that became known as Silicon Valley.
4. The electronics industry initially turned to semiconducting devices …	d) was centered in California.
5. Improvments in semiconductor devices led to …	e) so researchers turned their focus to solid crystals.

11. Using information of the text speak about the role of silicon in the development of the semiconductor industry.

12. Make a short summary of the text in written form.

Part B

13. Read the title of the following text. Make predictions about its contents.

14. Read the text and write key words and phrases revealing the contents of the text.

15. Divide the text into logical parts. In each part find the key sentence.

16. Find sentences which can be omitted as inessential in each logical part.

Return of the Vacuum Valve

Until the 1950s, all active electronic functions were performed by the vacuum valve. They were made up of metal electrodes arranged in a vacuum glass envelope. Their sizes varied, but even one of the latest valves had a volume of more than one cubic centimetre. When solid state devices were invented, one of their main attractions was their small size. As the technology developed, individual elements became smaller and smaller, until complete circuits could be designed on a single piece of silicon. This development resulted in the replacement of vacuum valves by transistors in receivers and low-power electronic systems. In high power transmitters vacuum valves continue to and thermionic emitters are still used where a free source of electrons is required as in cathode-ray tubes. But semiconductor devices proved to be poorly equipped to survive certain environments.

For example, when semiconductor devices are exposed to ionizing radiation in space and defence systems, they are bombarded by both neutral and charged particles, which cause fluctuations in current leading to failure of the device. Vacuum tubes are far more immune to such environments. Vacuum tubes work at much higher voltages than semiconductors and they have the potential to provide high frequency operation. Therefore some research centres have developed research programmes for producing micron-sized vacuum electronic devices. It is the semiconductor fabrication technology which now offers the opportunity of producing vacuum tubes as small as transistors.

There are many potential applications of vacuum microelectronics, but they all centre on the properties of field emitting devices. For many years a great deal of effort has been directed towards finding a cold electron source to replace the thermionic cathode in such devices as cathode ray tubes and traveling wave tubes. Most research programmes have concentrated on cold cathodes to take advantage of the small device size, low power consumption and high current densities which in rum will lead to high operating frequencies and fast switching.

17. Name the main problems of the text.

18. Find the paragraph in the text which describes one of the main attractions of solid state devices.

19. Explain why most research programmes have concentrated on cold cathodes as a source of electrons.

20. Make questions to the text.

21. Name advantages vacuum tubes have over solid state devices when they operate in certain environments.

22. Express your attitude to the facts given in the text. You may use the following phrases:

– It is full of interesting information…
– I find the text rather / very cognitive…
– I've learnt a lot…
– I don't agree with it…

23. Give a short summary of the text.

Part C

24. Look through the following text, define the information presented in it and entitle the text.

Text C

The property of semiconductors that makes them most useful for constructing electronic devices is that their conductivity may easily be modified by introducing impurities into their crystal lattice. The process of adding controlled impurities to a semiconductor is known as *doping*. The amount of impurity, or dopant, added to an *intrinsic* (pure) semiconductor varies its level of conductivity. Doped semiconductors are often referred to as *extrinsic*. By adding impurity to pure semiconductors, the electrical conductivity may be varied not only by the number of impurity atoms but also, by the type of impurity atom and the changes may be thousand folds and million folds.

The materials chosen as suitable dopants depend on the atomic properties of both the dopant and the material to be doped. In general, dopants that produce the desired controlled changes are classified as either electron acceptors or donors. A donor atom that activates (that is, becomes incorporated into the crystal lattice) donates weakly-bound valence electrons to the material, creating excess negative charge carriers. These weakly-bound electrons can move about in the crystal lattice relatively freely and can facilitate conduction in the presence of an electric field. Conversely, an activated acceptor produces a hole. Semiconductors doped with donor impurities are called *n-type*, while those doped with acceptor impurities are known as *p-type*. The n and p type designations indicate which charge carrier acts as the material's majority carrier. The opposite carrier is called the minority carrier, which exists due to thermal excitation at a much lower concentration compared to the majority carrier.

25. Find the following information in the text:

– what makes semiconductors the most useful for constructing electronic devices;
– what doping is;
– what the difference between intrinsic and extrinsic semiconductors is;
– two types of doped semiconductors;
– what *n* and *p* type designations indicate.

26. Speak about the importance of doping for constructing electronic devices.

APPENDIX

SUPPLEMENTARY READING

Text 1

1. Read the text.

2. Express the idea of each paragraph in one sentence.

3. Write a summary of the text in English.

What are Potential Harmful Effects of Nanoparticles?

Nanoparticles can have the same dimensions as some biological molecules and can interact with these. In humans and in other living organisms, they may move inside the body, reach the blood and organs such as the liver or the heart, and may also cross cell membranes. Insoluble nanoparticles are a greater health concern because they can persist in the body for long periods of time.

The parameters of nanoparticles that are relevant for health effects are nanoparticle size (smaller particles can be more dangerous), chemical composition and surface characteristics, and shape.

Inhaled nanoparticles can deposit in the lungs and then potentially move to other organs such as the brain, the liver, and the spleen, and possibly the foetus in pregnant women. Some materials could become toxic if they are inhaled in the form of nanoparticles. Inhaled nanoparticles may cause lung inflammation and heart problems.

The objective of nanoparticles used as drug carriers is to deliver more of the drug to the target cells, to reduce the harmful effects of the drug itself on other organs, or both. However, it is sometimes difficult to distinguish the toxicity of the drug from that of the nanoparticle.

With the exception of airborne particles reaching the lungs, information on the behaviour of nanoparticles in the body is still minimal. Assessment of the health implications of nanoparticles should take into account the fact that age, respiratory tract problems, and the presence of other pollutants can modify some of the health effects.

Information on the effects of nanoparticles on the environment is very scarce. However, it is likely that many conclusions drawn from human studies can be extrapolated to other species, but more research is needed.

Text 2

1. *Look at the title. Make your predictions about the contents of the text.*
2. *Divide the text into paragraphs.*
3. *Express the main idea of each paragraph in one sentence.*
4. *Summarize the text and be ready to retell it.*

Information Security

Information security means protecting information and information systems from unauthorized access, use, disclosure, disruption, modification or destruction. The terms information security, computer security and information assurance are frequently incorrectly used interchangeably. These fields are interrelated often and share the common goals of protecting the confidentiality, integrity and availability of information; however, there are some subtle differences between them. These differences lie primarily in the approach to the subject, the methodologies used, and the areas of concentration. Information security is concerned with the confidentiality, integrity and availability of data regardless of the form the data may take: electronic, print, or other forms. Computer security can focus on ensuring the availability and correct operation of a computer system without concern for the information stored or processed by the computer. Governments, military, corporations, financial institutions, hospitals, and private businesses amass a great deal of confidential information about their employees, customers, products, research, and financial status. Most of this information is now collected, processed and stored on electronic computers and transmitted across networks to other computers. Should confidential information about a business' customers or finances or new product line fall into the hands of a competitor, such a breach of security could lead to lost business, law suits or even bankruptcy of the business. Protecting confidential information is a business requirement, and in many cases also an ethical and legal requirement. For the individual, information security has a significant effect on privacy, which is viewed very differently in different cultures. The field of information security has grown and evolved significantly in recent years. As a career choice there are many ways of gaining entry into the field. It offers many areas for specialization including: securing networks and allied infrastructure, securing applications and databases, security testing, information systems auditing, business continuity planning and digital forensics science, to name a few.

Text 3

1. *Read the title of the following text and make your predictions about its contents.*
2. *Express the main idea of each paragraph in one sentence.*
3. *Say which facts presented in the text you've already been familiar with.*

Security Classification for Information

An important aspect of information security and risk management is recognizing the value of information and defining appropriate procedures and protection requirements for the information. Not all information is equal and so not all information requires the same degree of protection. This requires information to be assigned a security classification.

The first step in information classification is to identify a member of senior management as the owner of the particular information to be classified. Next, develop a classification policy. The policy should describe the different classification labels, define the criteria for information to be assigned a particular label, and list the required security controls for each classification.

Some factors that influence which classification information should be assigned include how much value that information has to the organization, how old the information is and whether or not the information has become obsolete. Laws and other regulatory requirements are also important considerations when classifying information.

The type of information security classification labels selected and used will depend on the nature of the organisation, with examples being:

– In the business sector, labels such as: Public, Sensitive, Private, Confidential.

– In the government sector, labels such as: Unclassified, Sensitive But Unclassified, Restricted, Confidential, Secret, Top Secret and their non-English equivalents.

– In cross-sectoral formations, the Traffic Light Protocol, which consists of: White, Green, Amber and Red.

All employees in the organization, as well as business partners, must be trained on the classification schema and understand the required security controls and handling procedures for each classification. The classification a particular information asset has been assigned should be reviewed periodically to ensure the classification is still appropriate for the information and to ensure the security controls required by the classification are in place.

Text 4

1. *Look through the text and entitle it.*
2. *Answer the questions.*
   1. What factors are connected with the problem of the tyrany of numbers?
   2. What kind of solution in the production of integrated circuits was found by Jack Kilby?
3. *Explain the essense of Jack Kilby's invention.*

With the small and effective transistor at their hands, electrical engineers of the 50s saw the possibilities of constructing far more advanced circuits than before. However, as the complexity of the circuits grew, problems started arising.

When building a circuit, it is very important that all connections are intact. If not, the electrical current will be stopped on its way through the circuit, making the circuit fail. Before the integrated circuit, assembly workers had to construct circuits by hand, soldering each component in place and connecting them with metal wires. Engineers soon realized that manually assembling the vast number of tiny components needed in, for example, a computer would be impossible, especially without generating a single faulty connection.

Another problem was the size of the circuits. A complex circuit, like a computer, was dependent on speed. If the components of the computer were too large or the wires interconnecting them too long, the electric signals couldn't travel fast enough through the circuit, thus making the computer too slow to be effective.

So there was a problem of numbers. Advanced circuits contained so many components and connections that they were virtually impossible to build. This problem was known as the tyranny of numbers.

In the summer of 1958 Jack Kilby at Texas Instruments found a solution to this problem. He was newly employed and had been set to work on a project to build smaller electrical circuits. However, the path that Texas Instruments had chosen for its miniaturization project didn't seem to be the right one to Kilby.

Because he was newly employed, Kilby had no vacation like the rest of the staff. Working alone in the lab, he saw an opportunity to find a solution of his own to the miniaturization problem. Kilby's idea was to make all the components and the chip out of the same block (monolith) of semiconductor material. When the rest of the workers returned from vacation, Kilby presented his new idea to his superiors. He was allowed to build a test version of his circuit. In September 1958, he had his first integrated circuit ready. It was tested and it worked perfectly!

Although the first integrated circuit was pretty crude and had some problems, the idea was groundbreaking. By making all the parts out of the same block of material and adding the metal needed to connect them as a layer on top of it, there was no more need for individual discrete components. No more wires and components had to be assembled manually. The circuits could be made smaller and the manufacturing process could be automated.

Jack Kilby is probably most famous for his invention of the integrated circuit, for which he received the Nobel Prize in Physics in the year 2000. After his success with the integrated circuit Kilby stayed with Texas Instruments and, among other things, he led the team that invented the hand-held calculator.

Text 5

1. Look through the text and entitle it.

2. Answer the questions.

1. What is the difference between three majour types of PCBs?
2. What is the difference between printed circuit boards and integrated circuits?

3. Explain the difference between two methods of connecting the components of PCBs?

A printed circuit board, or PCB[1], is a self-contained module of interconnected electronic components found in devices ranging from common beepers, or pagers, and radios to sophisticated radar and computer systems. The circuits are formed by a thin layer of conducting material deposited, or "printed", on the surface of an insulating board known as the substrate. Individual electronic components are placed on the surface of the substrate and soldered to the interconnecting circuits. Contact fingers along one or more edges of the substrate act as connectors to other PCBs or to external electrical devices such as on-off switches. A printed circuit board may have circuits that perform a single function, such as a signal amplifier, or multiple functions.

There are three major types of printed circuit board construction: single-sided, double-sided, and multi-layered. Single-sided boards have the components on one side of the substrate. When the number of components becomes too much for a single-sided board, a double-sided board may be used. Electrical connections between the circuits on each side are made by drilling holes through the substrate in appropriate locations and plating the inside of the holes with a conducting material. The third type, a multi-layered board, has a substrate made up of layers of printed circuits separated by layers of insulation. The components on the surface connect through plated holes drilled down to the appropriate circuit layer. This greatly simplifies the circuit pattern.

Components on a printed circuit board are electrically connected to the circuits by two different methods: the older "through hole technology" and the newer "surface mount technology". With through hole technology, each component has thin wires, or leads, which are pushed through small holes in the substrate and soldered to connection pads in the circuits on the opposite side. Gravity and friction between the leads and the sides of the holes keeps the components in place until they are soldered. With surface mount technology, stubby J-shaped or L-shaped legs on each component contact the printed circuits directly. A solder paste consisting of glue, flux, and solder are applied at the point of contact to hold the components in place until the solder is melted, or "reflowed", in an oven to make the final connection. Although surface mount technology requires greater care in the placement of the components, it eliminates the time-consuming drilling process and the space-consuming connection pads inherent with through hole technology. Both technologies are used today.

Two other types of circuit assemblies are related to the printed circuit board. An integrated circuit, sometimes called an IC[2] or microchip, performs similar functions to a printed circuit board except the IC contains many more circuits and components that are electrochemically "grown" in place on the surface of a very small chip of silicon. A hybrid circuit, as the name implies, looks like a printed circuit board, but contains some components that are grown onto the surface of the substrate rather than being placed on the surface and soldered.

Notes:
[1]PCB – Printed Circuit Board – печатная плата;
[2]IC – Integrated Circuit – интегральная схема.

Text 6

1. Look through the text and entitle it.
2. Answer the questions.

1. What advantages made ICs so popular in modern electronic devices?

2. What facts from the history of IC's invention are stated in the text?
3. What is the difference between Kilby's and Noyce's IC?

Integrated circuits were made possible by experimental discoveries which showed that semiconductor devices could perform the functions of vacuum tubes, and by mid-20th-century technology advancements in semiconductor device fabrication. The integration of large numbers of tiny transistors into a small chip was an enormous improvement over the manual assembly of circuits using discrete electronic components. The integrated circuit's mass production capability, reliability, and building-block approach to circuit design ensured the rapid adoption of standardized ICs in place of designs using discrete transistors.

There are two main advantages of ICs over discrete circuits: cost and performance. Cost is low because the chips, with all their components, are printed as a unit by photolithography and not constructed one transistor at a time. Furthermore, much less material is used to construct a circuit as a packaged IC die than as a discrete circuit. Performance is high since the components switch quickly and consume little power (compared to their discrete counterparts) because the components are small and close together. As of 2006, chip areas range from a few square millimeters to around 350 mm^2, with up to 1 million transistors per mm^2.

The idea of an integrated circuit was conceived by a radar scientist working for the Royal Radar Establishment of the British Ministry of Defence, Geoffrey W.A. Dummer (1909-2002), who published it at the Symposium on Progress in Quality Electronic Components in Washington, D.C. on May 7, 1952. He gave many symposia publicly to propagate his ideas.

Dummer unsuccessfully attempted to build such a circuit in 1956.

The integrated circuit can be credited as being invented by both Jack Kilby of Texas Instruments and Robert Noyce of Fairchild Semiconductor working independently of each other. Kilby recorded his initial ideas concerning the integrated circuit in July 1958 and successfully demonstrated the first working integrated circuit on September 12, 1958. In his patent application of February 6, 1959, Kilby described his new device as "a body of semiconductor material ... wherein all the components of the electronic circuit are completely integrated".

Kilby won the 2000 Nobel Prize in Physics for his part of the invention of the integrated circuit. Robert Noyce also came up with his own idea of integrated circuit, half a year later than Kilby. Noyce's chip had solved many practical problems that the microchip developed by Kilby had not. Noyce's chip, made at Fairchild, was made of silicon, whereas Kilby's chip was made of germanium.

Text 7

1. *Read the text.*
2. *Divide the text into paragraphs.*
3. *Express the idea of each paragraph in one sentence.*
4. *Write a summary of the text in English.*

A **computer virus** is a computer program that can copy itself and infect a computer without permission or knowledge of the user. However, the term “virus” is commonly used, albeit erroneously, to refer to many different types of malware programs. The original virus may modify the copies, or the copies may modify themselves, as occurs in a metamorphic virus. A virus can only spread from one computer to another when its host is taken to the uninfected computer, for instance by a user sending it over a network or the Internet, or by carrying it on a removable medium such as a floppy disk, CD, or USB drive. Meanwhile viruses can spread to other computers by infecting files on a network file system or a file system that is accessed by another computer. Viruses are sometimes confused with computer worms and Trojan horses. A worm can spread itself to other computers without needing to be transferred as part of a host, and a Trojan horse is a file that appears harmless. Both worms and Trojans will cause harm to computers when executed. Most personal computers are now connected to the Internet and to local area networks, facilitating the spread of malicious code. Today’s viruses may also take advantage of network services such as the World Wide Web, e-mail, Instant Messaging and file sharing systems to spread, blurring the line between viruses and worms. Furthermore, some sources use an alternative terminology in which a virus is any form of self-replicating malware. Some viruses are programmed to damage the computer by damaging programs, deleting files, or reformatting the hard disk. Others are not designed to do any damage, but simply replicate themselves and perhaps make their presence known by presenting text, video, or audio messages. Even these benign viruses can create problems for the computer user. They typically take up computer memory used by legitimate programs. As a result, they often cause erratic behavior and can result in system crashes. In addition, many viruses are bug-ridden, and these bugs may lead to system crashes and data loss.

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READ AND SPEAK FOR FULL TIME STUDENTS OF THE RADIOENGINEERING AND ELECTRONICS FACULTY

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