МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ
РОССИЙСКОЙ ФЕДЕРАЦИИ

ФГБОУ ВО «Воронежский государственный
технический университет»

С.Н. Каширский Н.В. Аленькова
Э.П. Комарова Ю.С. Балашов

АНГЛИЙСКИЙ ДЛЯ РАДИОИНЖЕНЕРОВ

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В учебном пособии представлен материал на английском языке, охватывающий основные разделы подготовки специалистов в области проектирования и технологии электронных средств: физические основы микроэлектроники, материаловедение, аналоговая и цифровая электроника, основы радиоэлектроники и связи, программное обеспечение систем связи.

Учебное пособие ориентировано на овладение терминологическим минимумом и на его основе понимание аутентичных текстов на английском языке без их перевода.

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д-р физ.-мат. наук, проф. Э.К. Алгазинов

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ПРЕДИСЛОВИЕ

Учебное пособие “Английский для радиоинженеров” предназначено для студентов второго курса, обучающихся по специальности 11.05.01 «Радиоэлектронные системы и комплексы», а также для бакалавров и магистров по направлению «Радиотехника». Уникальность и новизна данного пособия обусловлена тем, что существующие учебные пособия для технических вузов в недостаточной мере охватывают специфику каждой специальности, тексты для обучения часто носят обще-технический характер, таким образом, недостаточно полно отражают работу обучаемых с терминологическим словарем в области радиотехники и делают невозможным практическое использование английских радиотехнических понятий в их будущей профессиональной деятельности. В настоящее время большая часть радиотехнических терминов - интернациональна и используется как для выполнения научных исследований, так и для обеспечения образовательных функций и конкретных технических приложений, написанных в оригинале на основе английского языка.

Целью данного пособия является обучение будущих специалистов в области радиотехники, радиоэлектронных систем и комплексов специфике англоязычной технической литературы. Соответственно задачами пособия являются понимание профориентированных научно-технических аутентичных текстов на английском языке, овладение терминологическим минимумом по специальности, использование необходимой информации в профессиональной деятельности. Для достижения этой цели авторами предлагается методика работы, основанная на использовании разнообразных способов подачи материала, систематическом повторении лексики по темам, активном применении различных коммуникативных приемов.

В пособии делается акцент на развитие и совершенствование навыков чтения как приоритетного вида речевой деятельности, а также развитие умений аннотирования и реферирования оригинальной англоязычной литературы по специальностям радиотехника и радио-конструирование. Тексты, подготовленные для обучения, взяты из оригинальных источников и адаптированы в соответствии с целью данного учебного пособия. Материал,

вошедший в пособие, рассчитан на 120 часов аудиторной и внеаудиторной работы.

Пособие включает пять тематических глав, отражающих основные разделы научного направления «Радиоэлектроника и связь»:

1. Radio Communications (Радиосвязь)
2. Elements of Radio Systems (Элементы/ составляющие радиосистем)
3. Radio Communications Processing Functions (Функции обработки радиосвязи)
4. Wireless (Беспроводная связь)
5. Conductors, Semiconductors and Insulators (Проводники, полупроводники и диэлектрики)

Каждая тематическая глава разделена на пять базовых частей – занятий и одну заключительную часть – занятие по самостоятельной работе студента во внеурочное время. Каждое занятие рассчитано на 4 часа аудиторной и внеаудиторной работы.

Первые четыре занятия (Activity 1, Activity 2, Activity 3, Activity 4) каждой тематической главы представляют собой серию заданий, способствующих снятию грамматических и терминологических трудностей. В первом задании каждого занятия дано объяснение грамматических явлений в виде таблицы. Необходимо обратить внимание студентов на грамматические трудности, особенности, исключения, особенности использования.

Во втором задании студентам дается возможность закрепить усвоенный материал.

В третьем задании представлены слова и словосочетания, которые необходимо усвоить и запомнить. Для лучшего усвоения термины и словосочетания используются в контексте.

В четвертом задании дается аутентичный текст, который необходимо прочитать с использованием одного из четырех видов чтения: просмотрового, изучающего, поискового и ознакомительного. Выбор вида чтения определяется задачей, поставленной при работе с учебной литературой.

В пятом, шестом, седьмом, восьмом и девятом заданиях дан материал на снятие терминологических трудностей для понимания

текста, на проверку усвоения материала студентами.

Пятое занятие каждой тематической главы (Activity 5) носит творческий характер и посвящен обобщающей дискуссии. Студенты знакомятся с глоссарием и выполняют задания тренировочного характера с целью изучения радиотехнических терминов и последующего их использования в профессиональных ситуациях. Основной акцент переносится на развитие неподготовленной речи, свободной беседы. Подобное занятие требует от студентов участия в обсуждении определенной проблемы.

В шестой части (Outclass Activity) даны аутентичные тексты для домашнего чтения по тематике главы.

Система заданий, которой снабжены тексты, обеспечивает многократное повторение лексического и терминологического материала. Предтекстовые задания снимают терминологические трудности и способствуют накоплению словарного запаса, необходимого для работы над научно-техническими текстами по данной тематике.

Работа с пособием значительно облегчается за счет терминологического глоссария, в котором на английском языке дано толкование основных терминов и многокомпонентных терминологических единиц, а также общенаучная лексика по специальности радиотехника.

I. RADIO COMMUNICATIONS

CLASS ACTIVITY

ACTIVITY 1

Text 1.1: PRINCIPLES OF RADIO COMMUNICATIONS
Grammar: PRESENT SIMPLE. ACTIVE AND PASSIVE CONSTRUCTION

Task 1. Study the ways of expressing present actions in Active Voice and Passive Voice. Translate the sentences.

MEANS OF EXPRESSING PRESENT ACTIONS	EXAMPLE
Present Simple (Active Voice)	Radio waves belong to the electromagnetic radiation family, which includes X-ray, ultraviolet, and visible light.
Present Simple (Passive Voice)	The HF band is defined as the frequency range of 3 to 30 MHz.

Task 2. Find Active Voice and Passive Voice in the English sentences. Pay attention to the way they are expressed in the Russian equivalent.

1. Radio waves belong to the electromagnetic radiation family, which includes x-ray, ultraviolet, and visible light.	Радиоволны принадлежат к семейству электромагнитного излучения, которое включает ультрафиолетовые, рентгено-вские лучи и видимый свет.
2. Unlike water waves, radio waves propagate at the speed of light.	В отличие от водных волн, радиоволны распространяются со скоростью света.
3. The frequency of a radio wave is the number of repetitions or cycles it completes in a given period of time.	Частота радиоволны - это число повторений или циклов, совершенных в единицу времени.

4. Radio wavelength is the distance between crests of a wave.	Длина радиоволны - это расстояние между вершинами волны.
5. The HF band is defined as the frequency range.	ВЧ диапазоном называется промежуток частот.
6. Short wave of 3 to 30 MHz is applied to long-distance radio communication.	Короткая волна от 3 до 30 МГц используется для дальней радиосвязи.

Task 3. Study the given sentences where the following words and word combinations are used:

1. comprehension of basic electromagnetic radiation – *понимание основ электромагнитного излучения*

Developing an understanding of radio communications begins with the comprehension of basic electromagnetic radiation.

2. electromagnetic radiation family – *группа электромагнитного излучения*

Radio waves belong to the electromagnetic radiation family.

3. radio wave amplitude – *амплитуда радиоволны*

Radio wave amplitude, or strength, can be visualized as its height being the distance between its peak and its lowest point.

4. propagate – *распространять*

Radio waves propagate at the speed of light.

5. frequency – *частота*

Frequency is measured in Hertz (Hz).

Task 4. Read the following text carefully paying attention to the italicized words and word combinations and try to understand the content of the text.

TEXT 1.1:

PRINCIPLES OF RADIO COMMUNICATIONS

1. Developing an understanding of *radio communications* begins with the comprehension of basic electromagnetic radiation. Radio waves belong to the *electromagnetic radiation family*, which includes X-ray, ultraviolet, and visible light – forms of energy we use every day. Much like the gentle waves that formed when a stone is tossed into a still lake, radio signals radiate outward, or propagate, from a transmitting antenna. However, unlike water waves, radio waves propagate at the *speed of light*. We characterize a radio wave in terms of its amplitude, frequency, and *wavelength* (figure 1).

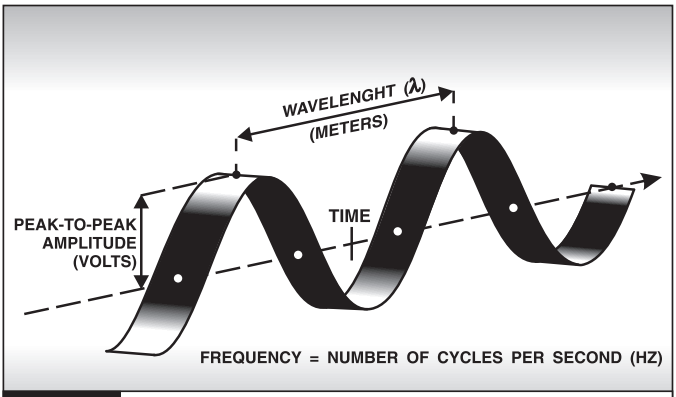

Figure 1 **Properties of a Radio Wave**

2. Radio wave amplitude, or strength, can be visualized as its height being the distance between its peak and its lowest point. Amplitude, which is measured in volts, is usually expressed by engineers in terms of an average *value* called root-mean-square, or RMS.

3. The *frequency* of a radio wave is the number of repetitions or cycles it completes in a given period of time. Frequency is measured in Hertz (Hz); one Hertz *equals* one cycle per second. Thousands of Hertz are expressed as kilohertz (kHz), and millions of Hertz as megahertz (MHz). You would typically see a frequency of 2 182 000 Hertz, for example, written as 2 182 kHz or 2,182 MHz.

4. Radio wavelength is the distance between *crests* of a wave. The product of wavelength and frequency is a constant that is equal to the

speed of propagation. Thus, as the frequency *increases*, wavelength *decreases*, and vice versa. Since radio waves propagate at the speed of light (300 million meters per second), you can easily determine the wavelength in meters for any frequency by dividing 300 by the frequency in megahertz. So, the wavelength of a 10-MHz wave is 30 meters, determined by dividing 300 by 10.

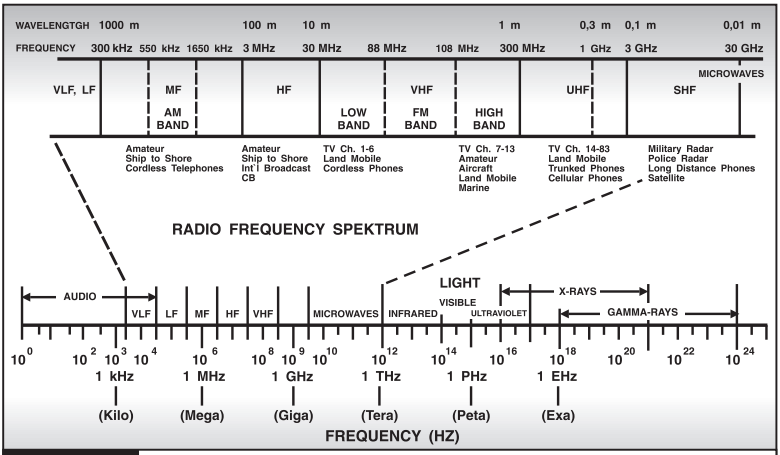

Figure 2 **Radio Frequency Spectrum**

5. In the radio frequency spectrum (figure 2), the usable *frequency range for radio waves* extends from about 20 kHz (just above sound waves) to above 30,000 MHz. A wavelength at 20 kHz is 15 kilometers long. At 30,000 MHz, the wavelength is only 1 centimeter. The HF band is defined as the frequency range of 3 to 30 MHz. In practice, most HF radios use the spectrum from 1.6 to 30 MHz. Most long haul communications in this band take place between 4 and 18 MHz. Higher frequencies (18 to 30 MHz) may also be available from time to time, depending on ionospheric conditions.

6. In the early days of radio, HF frequencies were called short wave because their wavelengths (10 to 100 meters) were shorter than those of commercial *broadcast stations*. The term is still applied to long-distance radio communications.

Task 5. Fill in the gaps with the correct variants:

1. Radio .....belong to the electromagnetic radiation family.
a) signals *b) waves* *c) bands*

2. Unlike .....waves radio waves propagate at the speed of light.
a) radio b) water c) frequency

3. Amplitude of radio waves is usually measured in ……..
a) MHz b) volts c) watts

4. The frequency of a radio wave is the..... of repetitions of cycles.
a) use b) number c) quantity

5. Thousands of hertz..... kilohertz (kHz).
a) are determined in b) are expressed as c) are shown in

Task 6. Match up the words with their definitions.

comprehension	to separate
amplitude	to set a part for a particular purpose
to propagate	to lay off
frequency	to stretch and to draw out to the full length
radio wavelength	to transmit
to divide	distance between crests of a wave
to allocate	the distance between its peak and its lowest point
to extend	state of being frequent
band	a capacity of the mind to perceive
to measure	gamut

Task 7. Find key sentences in each paragraph and underline them.

Task 8. Match up the given titles to each paragraph in the TEXT 1.1.

1. Comprehension of basic electromagnetic radiation.

2. Radio wave amplitude and its measurement.

3. Frequency of radio waves.

4. Propagation of radio waves.

5. Frequency range for radio waves.

6. Early days of radio.

Task 9. Answer the following questions organizing your thoughts.

1. What does developing an understanding of radio communications begin with?

2. What do radio waves include?

3. How are radio waves characterized?

4. How can the radio wave amplitude be visualized?

5. What is the frequency of a radio wave?

6. What is a radio frequency spectrum?

7. How is the HF band defined?

8. What takes place between 4 and 18 MHz?

9. What is a short wave?

10. What extends from about 20 kHz?

Task 10. Sum up the text using the following plan:

1. Comprehension of basic electromagnetic radiation.

2. Radio wave amplitude.

3. Frequency of radio waves.

4. Propagation of radio waves.

5. High frequency band.

ACTIVITY 2

Text 1.2: IONOSPHERE AND HF RADIO PROPAGATION
Grammar: PARTICIPLE II

Task 11. Look through the table and study the functions of Participle II.

FUNCTION	EXAMPLE
To be + Participle II (Passive Voice) Present; Past	Electrons are stripped from atoms.
Participle II attribute	Electrically charged particles extend from 50 to 600 km above the earths surface.
Adverbial modifier	When ionized, the layers are absorbed and refracted.

Task 12. Find Participle II in the English sentences. Pay attention how it is expressed in the Russian equivalent.

1. The ionosphere is a region of electrically charged particles or gases.	Ионосфера – это область электрически заряженных частиц или газов.
2. When the ionosphere becomes heavily ionized the gases may even glow and be visible.	Когда ионосфера становится сильно ионизированной, газы могут даже блестеть и становятся видимыми.
3. When radio waves strike these ionized layers, depending on frequency, some are completely absorbed.	Когда радиоволны ударяются об ионизированные слои, то в зависимости от частоты, некоторые полностью абсорбируются.
4. The most heavily ionized region of the ionosphere is the F layer.	Самый сильно ионизированный слой ионосферы – это F-слой.

5. The same frequencies used at night will penetrate the F- layer.	Те же самые частоты, используемые ночью, пройдут через F-слой.

Task 13. Skim the following text and try to understand the subject-matter of the text.

TEXT 1.2:

IONOSPHERE AND HF RADIO PROPAGATION

1. The ionosphere is a region of electrically charged particles or gases in the earth's atmosphere, extending from approximately 50 to 600 km (30 to 375 miles) above the earth's surface. Ionization, the process in which electrons are stripped from atoms and produce electrically charged particles, results from solar radiation. When the ionosphere becomes heavily ionized, the gases may even glow and be visible. This phenomenon is known as Northern and Southern Lights.

2. Why is the ionosphere important in HF radio? Well, this blanket of gases is like nature's satellite, actually making most BLOS radio communications possible. When radio waves strike these ionized layers, depending on frequency, some are completely absorbed, others are refracted so that they return to the earth, and still others pass through the ionosphere into outer space. Absorption tends to be greater at lower frequencies, and increases as the degree of ionization increases.

3. The angle at which sky waves enter the ionosphere is known as the incident angle (figure 3).

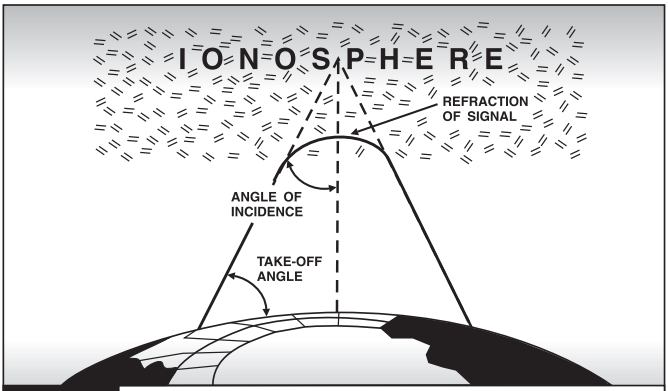

Figure 3 **Incident Angle**

This is determined by wavelength and the type of transmitting antenna. Like a billiard ball bouncing off a rail, a radio wave reflects from the ionosphere at the same angle it hits it.

Thus, the incident angle is an important factor in determining communications range. If you need to reach a station that is relatively far from you, you would want the incident angle to be relatively large. To communicate with a nearby station, the incident angle should be relatively small.

4. The incident angle of a radio wave is critical, because if it is too nearly vertical, it will pass through the ionosphere without being refracted back to earth. If the angle is too great, the waves will be absorbed by the lower layers before reaching the more densely ionized upper layers. So, the incident angle must be sufficient for bringing the radio wave back to the earth yet not so great that it will lead to absorption.

5. Within the ionosphere, there are four layers of varying ionization (Figure 4).

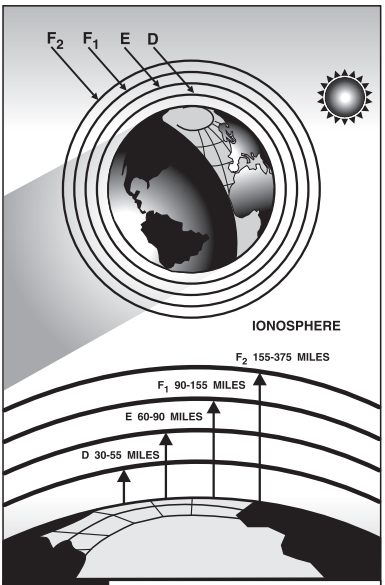

Figure 4 **Regions of the Ionosphere**

Since the ionization is caused by the solar radiation, the higher layers of the ionosphere tend to be more dense, while the lower layers, protected by the outer layers, experience less ionization. Of these layers, the first, discovered in the early 1920s by Appleton, was designated E for electric

waves. Later, D and F were discovered and noted by these letters. Additional ionospheric phenomena were discovered through the 1930s and 1940s, such as sporadic E and aurora. A, B, and C are still available for further discoveries.

6. In the ionosphere, the D layer is the lowest region affecting HF radio waves. Ionized only during the day, the D layer reaches maximum ionization when the sun is at its zenith and dissipates quickly toward sunset.

7. The E layer reaches maximum ionization at noon. It begins dissipating toward sunset and reaches minimum activity at midnight. Irregular cloud-like formations of ionized gases occasionally occur in the E layer. These regions, known as sporadic E, can support propagation of sky waves at the upper end of the HF band and beyond.

8. The most heavily ionized region of the ionosphere, and therefore the most important for long haul communications, is the F layer. At this altitude, the air is thin enough that the ions and electrons recombine very slowly, so the layer retains its ionized properties even after sunset.

9. In the daytime, the F layer consists of two distinct layers, F1 and F2. The F1 layer, which exists only in the daytime and is negligible in winter, is not important to HF communications. The F2 layer reaches maximum ionization at noon and remains charged at night, gradually decreasing to a minimum just before sunrise.

10. During the day, sky wave reflection from the F2 layer requires wavelengths short enough to penetrate the ionized D and E layers, but not so short as to pass through the F-layer. Generally, frequencies from 10 to 20 MHz will accomplish this, but the same frequencies used at night would penetrate the F layer and pass into outer space. The most effective frequencies for long haul nighttime communications are normally between 3 and 8 MHz.

Task 14. Match up the words with the definitions.

wave reflection	to break up and drive off
long-haul communication	distance between successive identical parts of a wave
to strip from	echoing
layer	to take the covering from

wavelength	long distance transmission
to dissipate	region
ionosphere	the part of the earth atmosphere beginning at an altitude of about 30 miles.

Task 15. Comprehension check. Answer the following questions:

1. What is the ionosphere?

2. What happens when radio waves strike?

3. What does figure 3 illustrate?

4. What is the ionization caused by within the ionosphere?

5. Can you name the layers of the ionosphere that you know?

6. What is the lowest region affecting HF radio waves in the ionosphere?

7. Do the irregular cloud-like formations of ionized gases occasionally occur in the D layer or in the E layer?

8. Is the F layer the most heavily ionized region of the ionosphere?

9. What layer is the most important for long haul communications?

10. What are the most effective frequencies for long-haul nighttime communications?

ACTIVITY 3

Text 1.3: FACTORS AFFECTING ATMOSPHERIC IONIZATION
Grammar: PARTICIPLE I

Task 16. Study the functions of Participle I.

FUNCTION	EXAMPLE
1. attribute	Factors affecting atmospheric ionization
2. adverbial modifiers of time	Having reached atmosphere, atoms back up.

Task 17. Find Participle I in the English sentences. Pay attention to the way it is expressed in the Russian equivalent.

1. Sky waves pass through the highly charged D and F layers reducing the communication range.	Радиоволны в атмосфере проходят через сильно заряженные слои D и F, уменьшая диапазон связи.
2. Signals arriving at the F layer are stronger.	Сигналы, приходящие на слой F, сильнее.
3. Charged particles from the magnetic storms have a scattering effect.	Частицы, заряженные в результате магнитных бурь, обладают эффектом рассеивания.
4. A received signal may be comprised of the components arriving via several routes.	Принятый сигнал может включать компоненты, приходящие по нескольким каналам.
5. The effects of multipath spread can be minimized by selecting a frequency.	Воздействие многолучевого распространения можно минимизировать, выбрав частоту.

Task 18. Skim the following text and try to understand the subject-matter of the text.

TEXT 1.3:

FACTORS AFFECTING ATMOSPHERIC IONIZATION

1. The intensity of solar radiation and therefore ionization varies periodically. Hence, we can predict solar radiation intensity based on time of day and the season, for example, and make adjustments in equipment to limit or optimize ionization effects.

2. Ionization is higher during spring and summer because the hours of daylight are longer. Sky waves are absorbed or weakened as they pass through the highly charged D and E layers, reducing, in effect, the communication range of most HF bands.

3. Because there are fewer hours of daylight during autumn and winter, less radiation reaches the D and E layers. Lower frequencies pass easily through these weakly ionized layers. Therefore, signals arriving at the F layer are stronger and are reflected over greater distances.

4. Another longer term periodic variation results from the 11-year sunspot cycle (Figure 5). Sunspots generate bursts of radiation that cause higher levels of ionization. The more sunspots, the greater the ionization. During periods of low sunspot activity, frequencies above 20 MHz tend to be unusable because the E and F layers are too weakly ionized to reflect signals back to the earth. At the peak of the sunspot cycle, however, it is not unusual to have worldwide propagation on frequencies above 30 MHz.

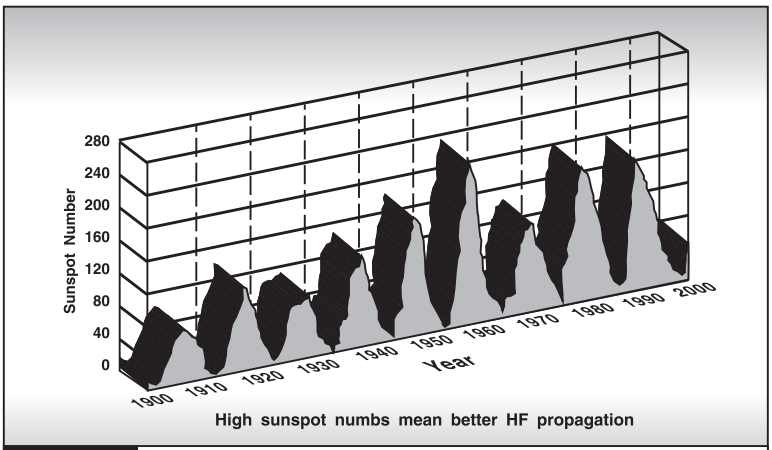

Figure 5 **Sunspot Cycle**

5. In addition to these regular variations, there is a class of unpredictable phenomena known as sudden ionospheric disturbances (SID), which can affect HF communications as well. SIDs, random events due to solar flares, can disrupt sky wave communication for hours or days at a time. Solar flares produce intense ionization of the D layer, causing it to absorb most HF signals on the side of the earth facing the sun.

6. Magnetic storms often follow the eruption of solar flares within 20 to 40 hours. Charged particles from the storms have a scattering effect on the F layer, temporarily neutralizing its reflective properties.

7. Because ionospheric conditions affect radio wave propagation, communicators must determine the best way to optimize radio frequencies at a particular time. The highest possible frequency that can be used to transmit over a particular path under given ionospheric conditions is called the Maximum Usable Frequency (MUF). Frequencies higher than the MUF penetrate the ionosphere and continue into space. Frequencies lower than the MUF tend to refract back to earth.

8. As frequency is reduced, the amount of absorption of the signal by the D layer increases. Eventually, the signal is completely absorbed by the ionosphere. The frequency at which this occurs is called the Lowest Usable Frequency (LUF). The “window” of usable frequencies, therefore, lies between the MUF and LUF.

9. Generally, the FOT is lower at night and higher during the day. These frequencies are illustrated in Figure 6.

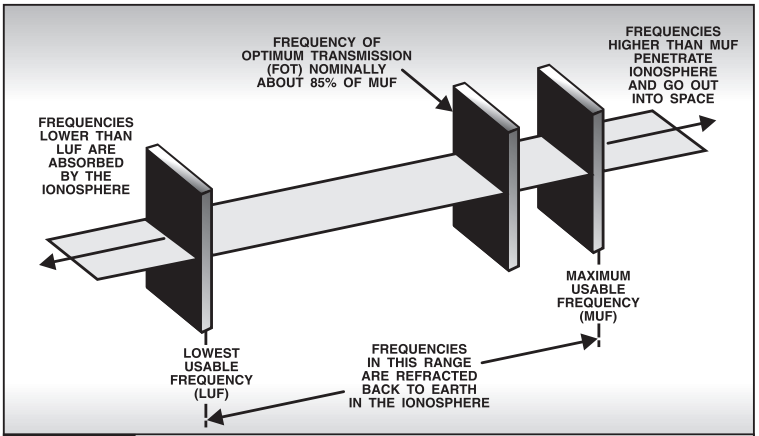

Figure 6 **MUF, LUF and FOT Frequencies**

10. In addition to frequency, the route the radio signal travels must also be considered in optimizing communications. A received signal may be comprised of components arriving via several routes, including one or more sky wave paths and a ground wave path. The arrival times of these components differ because of differences in path length; the range of time differences is the multipath spread. The effects of multipath spread can be minimized by selecting a frequency as close as possible to the MUF.

Task 19. Study the following sentences. Then, cover the left part and translate them from Russian into English:

1. Ionization is higher during spring and summer because the hours of daylight are longer.	Ионизация выше весной и летом, поскольку день длиннее.
2. Sky waves are absorbed or weakened.	Волны в атмосфере поглощаются или ослабляются.
3. Signals arriving at the F layer are stronger.	Сигналы, приходящие на F- слой, сильнее.
4. Atoms have a scattering effect on the F layer.	Атомы имеют рассеивающий эффект в F-слое.
5. The Frequency of Optimum Transmission (FOT) is nominally 85 percent of the MUF.	Оптимальная рабочая частота передачи обычно составляет 85% от максимально применимой частоты (МПЧ).

Task 20. Match up the words with the definitions.

ionization	one of the dark spots that appears from time to time
transmission	agitation/ storm/ perturbation
disrupt a sky wave	solar flare
sun burst	an energy, required to move electron
ionospheric disturbance	disconnect a signal
sunspot	wave propagation

Task 21. Answer the following questions:

1. During what seasons is the intensity of solar radiation higher?

2. What is the ionization?

3. Are signals arriving at the F layer stronger and reflected over greater distances?

4. What happens with the sky wave as it passes through the highly charged D and E layers?

5. Do sunspots generate bursts of radiation and cause higher levels of ionization?

6. Can the sudden ionospheric disturbances (SID) affect HF communications?

7. Do the charged particles from the storms have a scattering effect on the D layer?

8. What is called the Maximum Usable Frequency?

9. The FOT is lower at night and higher during the day, isn't it?

10. Can the effects of multipath spread be minimized by selecting a frequency as close as possible to the MUF?

Task 22. Which of the following do you think is true (T) or false (F)?

1. The intensity of solar radiation and therefore ionization varies periodically.
2. Ionosphere is higher during spring and summer.
3. Lower frequencies pass easily through the ionized layers.
4. Sunspots generate bursts of radiation that cause higher levels of ionization.
5. Ionospheric disturbance can affect HF communications.
6. Charged particles from the atom do not have a scattering effect.
7. The highest possible frequency can be used to transmit over a particular path under the given ionospheric condition is called (MUF).
8. Signal is not completely absorbed by the ionosphere.
9. Optimizing communications are necessary for transmission of radio signal.

ACTIVITY 4

Text 1.4: HF MODEMS
Grammar: PREPOSITIONS

Task 23. Try to define the meaning of prepositions of time, place and directions, purpose.

1. A demodulator converts audio back to digital voltage levels, Harris' RF-5000 radios are equipped with built-in high-speed modems.

2. The output of the modulator is an audio signal that is one of two possible tones. HF FSK systems are limited to data rates less than 75 bps due to the effect of multipath propagation.

3. The serial tone modem carries information on a single audio tone. Harris currently has its fourth generation of high-speed modems on the market.

4. FEC adds redundant data to the data stream to allow the data receiver to detect and correct errors.

Task 24. Find prepositions in the following English sentences. Pay attention how they are expressed in the Russian equivalent.

1. Data is entered by columns in a matrix identical to that at the transmitter.	Данные столбцами вводятся в матрицу, подобную той, что находится в передатчике.
2. HF-modems fall into three basic categories: 1) modems with low-speed frequency shift keying (FSK); 2) high-speed parallel tone modems; and 3) high-speed serial (single) tone modems	ВЧ модемы подразделяются на 3 основные категории:1) модемы с медленной частотной манипуляцией; 2) высокоскоростные модемы с параллельным тоном; 3) высокоскоростные модемы с последовательным (одиночным) тоном.
3. HF FSK system are limited to data rates less than 75 bps due to the effects of multipath propagation.	ВЧ система имеет ограничения по скорости данных 75 бит/с, из-за эффекта многолучевого распространения.

Task 25. Skim the following text and try to understand the subject- matter of the text.

TEXT 1.4:

HF MODEMS

1. A conventional voice radio cannot transmit data directly. Data digital voltage levels must be converted to audio, using a device called a modulator, which applies the audio to the transmitter. Conversely, at the receiver, a demodulator converts audio back to digital voltage levels. Harris' RF-5000 radios are equipped with built-in high-speed modems (the Modulator and the DEModulator, packaged together), which permit the radios to operate with either voice or data inputs.

2. HF modems fall into three basic categories: (1) modems with slow-speed frequency shift keying (FSK); (2) high-speed parallel tone modems; and (3) high-speed serial (single) tone modems.

The simplest modems employ FSK to encode binary data (0s and 1s) (see figure 7). The input of the modulator is a digital signal that takes one of two possible voltage levels. The output of the modulator is an audio signal that is one of two possible tones. HF FSK systems are limited to data rates less than 75 bps due to the effects of multipath propagation. Higher rates are possible with multi-tone FSK (MFSK), which uses a greater number of frequencies.

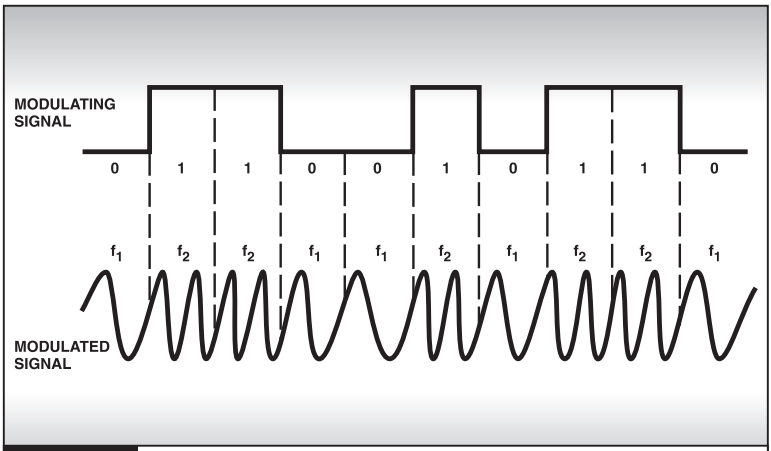

Figure 7 **Frequency Shift Keying**

3. High-speed HF modem technology, using both parallel and serial tone waveforms to allow transmission at up to 4800 bps, was pioneered by Harris in the early 1980s. The serial tone modem carries information on a single audio tone. This provides vastly improved data communications on HF channels, including greater robustness, reduced sensitivity to interference, and a higher data rate with powerful forward error correction (FEC), described in the next section. Harris currently has its fourth generation of high-speed modems on the market. Harris RF Communication's engineers use several different approaches to avoid data transmission problems.

4. FEC adds redundant data to the data stream to allow the data receiver to detect and correct errors. An important aspect of this concept is that it does not require a return channel for the acknowledgment. If a data receiver detects an error, it simply corrects it and accurately reproduces the original data without notifying the data sender that there was a problem.

5. The FEC coding technique is most effective if errors occur randomly in a data stream. The HF medium, however, typically introduces errors that occur in bursts that is, intervals with a high bit error ratio (BER) in the channel are interspersed with intervals of a low BER. To take full advantage of the FEC coding technique, it's best to randomize the errors that occur in the channel by a process called interleaving (figure 8).

For example, at the modulator, the data stream enters a 9-row by 10-column matrix. The blocks are entered by rows and unloaded by columns. When the data stream leaves the matrix for transmission, the sequence of output bits will be 1, 11, 2 1, and so on.

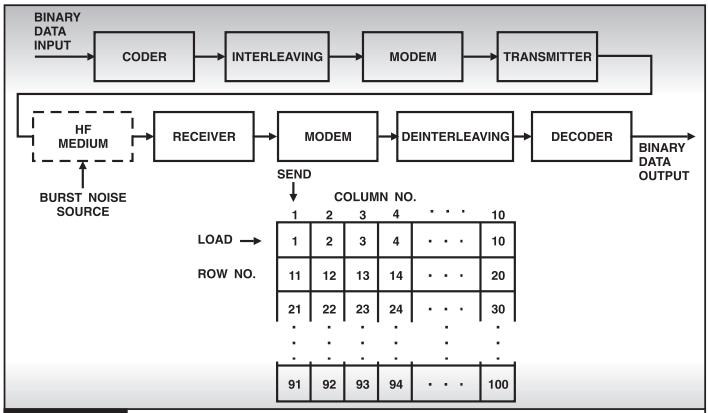

Figure 8 **Interleaving Operation**

6. At the demodulator, the process is reversed by de-interleaving. Data is entered by columns in a matrix identical to that at the transmitter. It is read out in rows, restoring the sequence of data to its original state. Thus, if a burst was to cause 9 consecutive bits to be in error, no more than 3 of them will fall in any 30-bit sequence of bits after de-interleaving. Then, if an FEC coding technique was used, the errors would be corrected.

Task 26. Comprehension check:

1. What do we call a modulator?

2. Does a demodulator convert audio back to digital voltage levels?

3. Do the built-in high-speed modems permit the radios to operate with either voice or data inputs?

4. Which categories of HF-modems do you know?

5. What do the simplest modems employ to encode binary data (0s and 1s)?

6. High-speed HF modem technology uses both parallel and serial tone waveforms to allow transmission at up to 4800 bps, doesn't it?

7. What does the FEC system provide if a data receiver detects an error?

8. Is the FEC coding technique effective if errors occur randomly in a data stream?

9. What are interleaving and de-interleaving processes?

Task 27. Study the following sentences paying attention to their translation. Cover one of the sides and translate on your own. Then check up:

1. Data voltage levels must be converted to audio, using a device called a modulator.	Уровни напряжения цифровых данных должны быть преобразованы в звуковой сигнал с помощью устройства называемого модулятором.

2. A demodulator converts audio back to digital voltage level.	Демодулятор преобразует звуковой сигнал обратно в уровень напряжения цифровых данных.
3. The simplest modems employ FSK to encode binary data.	Наиболее простые модели модемов применяют частотную манипуляцию (ЧМн) для кодирования двоичных данных.
4. FEC adds redundant data to the data stream to allow the data receiver to detect and correct errors.	Система коррекции ошибок с избыточным кодированием добавляет избыточные данные в поток данных, чтобы позволить устройству приема данных обнаружить и исправить ошибки.
5. The FEC coding technique is most effective if errors occur randomly in a data stream.	Технический прием коррекции ошибок с избыточным кодированием является наиболее эффективным, если ошибки возникают в потоке данных произвольно.
6. At the demodulator, the process is reversed by de-interleaving.	В демодуляторе происходит обратный процесс, называемый обращенным перемежением.

Task 28. Fill in the gaps with the correct variants:

slow-speed, errors, to allow, converts, 10-column, bursts, redundant, to detect, tone modems, converted, high-speed, correct, reversed

1. Data digital voltage levels must be ..... to audio.

2. A demodulator ..... audio back to digital voltage levels.

3. HF modems fall into three basic categories: 1) modems with .....FSK; 2) high-speed parallel ..... ; 3) ..... serial (single) tone modems.

4. FEC adds ..... data to the data stream ..... the data receiver ..... and ..... errors.

5. The HF medium introduces ..... that occur in .....

6. The data stream enters a 9-row by ..... matrix.

7. At the demodulator the process is..... by de-interleaving.

Task 29. Sum up the text using the following plan:

1. Modulator.

2. Demodulator.

3. HF modems: three basic categories.

4. High-speed HF modem technology.

5. Error control.

ACTIVITY 5: VOCABULARY WORK AND DISCUSSION

Task 30. Explain the meanings of the following words/ word combinations:

Electromagnetic radiation, radio wave, frequency, to dissipate, ionization, to absorb, electrical charge.

Task 31. Try to translate the following sentences into Russian without using a dictionary:

1. Sky waves pass through the highly charged D and E layers.

2. The D layer reaches maximum ionization when the sun is at its zenith and dissipates quickly toward sunset.

3. The ionosphere is a region of electrically charged particles or gases in the earth's atmosphere.

4. Radiowaves belong to electromagnetic radiation family.

5. Sunspots generate bursts of radiation that cause higher levels of ionization.

Task 32. For the words given in A column find the Russian equivalent in B column.

A	B
to absorb	ионосфера
burst	рассеивать
ionosphere	вспышка
to dissipate	распространяться
frequency	заряжать
electromagnetic radiation	электромагнитное излучение
to charge	радиоволна
radiowave	амплитуда
amplitude	поглощать
to propagate	частота

Task 33. Define the meanings of such words using English-English dictionary. The first example is given to you.

1. Ionosphere – a region of electrically charged particles or gases in the earth's atmosphere or extending from 50 to 600 kilometers (approximately 30 to 375 miles) above the earth's surface.

2. Burst of radiation
3. Radiowave amplitude
4. HF modem

Task 34. Here are some words you may find difficult in the following sentences which have several meanings. Decide which meaning is the correct one in the given sentences:

1. ..... is a region of electrically charged particles or gases.

1) ionosphere
2) stratosphere
3) absorption

2. Radio signals radiate or ..... from a transmitting antenna.

1) extend
2) allocate
3) propagate

3. The D layer reaches maximum ionization when the sun is at the zenith and ..... quickly toward sunset.

1) dissipates
2) spreads
3) strikes from

4. We characterize a radio wave in terms of its ..... and frequency.

1) amplitude
2) modulation
3) absorption

Task 35. Some acronyms are given. Try to find the meaning of each of them using a glossary.
Example: RMS – Root Mean Square

HF band, BLOS, SID, FOT, MUF, LUF, FEC, FSK, BER

Task 36. Choose the best variant to complete each sentence using acronyms:
Pattern: Amplitude, which is measured in volts is usually expressed by engineers in terms of an average value called root mean square.
– RMS – ~~FOT~~ – ~~LUF~~
See keys at the end of the Activity V.

1. Why is the ionosphere in HF Radio? Well, this blanket of gases is like nature's satellite, actually making most (BLOS, HF, FOT).

2. Class of unpredictable phenomena known as (SID, LUF, BER) can affect High Frequency Communications.

3. (HF, FSK, MUF) frequencies were called short wave because their

wavelengths (10 to 100 meters) were shorter than those of commercial broadcast stations.

4. The highest possible frequency that can be used to transmit over a particular path under given ionospheric conditions is called the (MUF, FOT, LUF).

5. The frequency at which the signal is completely absorbed by the ionosphere is called the (LUF, FEC, FSK).

DISCUSSION

Working with a partner do the following tasks. Share your ideas with the whole group.

1. Can you name the main principles of radio communication?
2. Use the figure 8 and give explanations about the advantages of FEC over BER.
3. Discuss the problems of radio wave propagation in different layers of the ionosphere.
4. Discuss the properties of a radio wave.
5. Find and solve the problems of the radio frequency spectrum with the help of figure 2.
6. Share your opinion on high band extension.

Keys: 1. BLOS; 2. SID; 3. HF; 4. MUF; 5. LUF

OUTCLASS ACTIVITY

Task 37. Read the following text and give the written translation using your dictionary and paying attention to Active and Passive Constructions.

TEXT 1:

ADAPTIVE RADIO TECHNOLOGY

1. The constantly changing properties of the ionosphere, as well as random noise and interference, cause disruptions in HF communications.

In the past, a skilled radio operator was required to establish communications and to continually adjust operating parameters. Today, this function is fully automatic. Harris RF Communications provides adaptive radio systems, pioneered in the early ’80s, that can react rapidly

to changing propagating conditions and use feedback from Real Time Channel Evaluation (RTCE) techniques to select frequencies, adjust data rates, or change modulation schemes. Two of the many adaptive processes are Automatic Link Establishment (ALE) and Link Quality Analysis (LQA). Because of Harris' previous experience with adaptive radio technology, the company was asked to become a member of the United States Military Standard Committee to develop the ALE standard.

2. ALE is a technique that permits HF radio stations to call and link on the best HF channel automatically without operator assistance. Harris pioneered the manufacture of adaptive communications equipment with AUTOLINK. In addition, Harris is a leader in the development of advanced ALE techniques that comply with MIL-STD-188-141A and FED-STD-1045A.

3. Typically, ALE systems make use of recently measured radio channel characteristics (LQA data) stored in a memory "matrix." The system works much like a telephone in that each radio in a network is assigned an address (ID). When not in use, each radio receiver constantly scans through its assigned frequencies, listening for calls addressed to it.

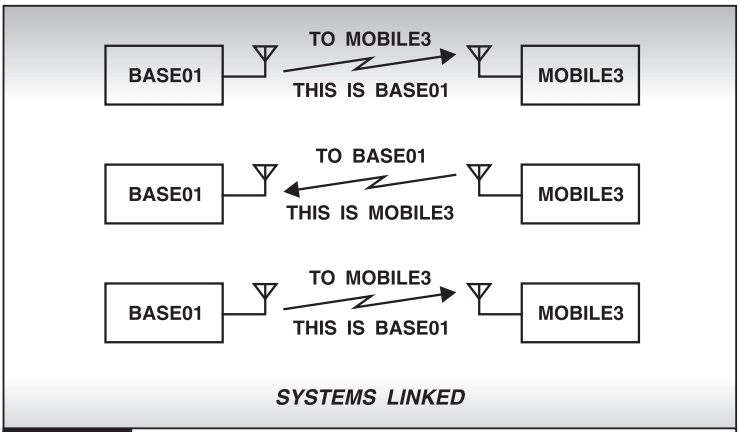

Figure 9 **ALE System Handshake**

4. To reach a specific station, the caller simply enters an ID just like dialing a phone number. The radio consults its LQA matrix and selects the best available assigned frequency. It then sends out a brief message containing the ID of the destination. When the receiving station "hears" its address, it stops scanning and stays on that frequency. The two stations automatically conduct a "handshake" to confirm that a link is established

and they are ready to communicate (figure 9). The receiving station, which was completely silent, will typically emit a ringing signal to alert the receiving operator of an incoming call. At the conclusion of the call, one of the stations “hangs up”, a disconnect signal is sent to the other station, and they each return to the scanning mode.

5. An HF communications system has a number of channels assigned to it. A system incorporating LQA capability selects the best channel. Here’s how it works in an adaptive system.

6. At prescribed intervals, a station in a network will attempt to link on each of its assigned frequencies and measure the signal quality on each linked frequency. These quality scores are stored in a matrix. When a call is initiated, the radio checks its “memory” to determine the best quality frequency for the call to the desired station. It then attempts to link on that frequency. If the link cannot be established, it will try again on the next best frequency, and so on, until a link is established.

ADDRESS	CHANNELS				
	01	02	03	04	05
BASE04	60	33	12	81	23
MOBILE2	10	--	48	86	21
MOBILE3	--	--	29	52	63
GBB122	21	00	00	45	--

Figure 10 **LQA Matrix for BASE 01**

7. Figure 10 shows a simplified LQA matrix for station BASE01. The channel numbers represent programmed frequencies, and the numbers in the matrix are the most recent channel-quality scores. Thus, if an operator wanted to make a call from BASE01 to MOBILE3, the radio would attempt to call on channel 05, which has the highest LQA score.

8. When making multi-station calls, the radio selects the channel with the best average score. Thus, for a multi-station call to all the addresses in the matrix, channel 04 would be selected.

9. Adaptive radio technology is further enhanced by the use of computer controllers, which permit modem data rate selection based on channel conditions, optimum antenna choice, automatic adjustment of transmitted power level, automatic nulling and elimination of interfering signals, and selection of modem modulation and coding schemes. The benefit is that these adaptive schemes are largely automatic and improve communications without operator intervention. Thus, the requirement for an operator with high technical knowledge has been significantly reduced.

Task 38. Read the text 2 and sum it up:

TEXT 2:

HF SYSTEMS AND APPLICATIONS

1. HF radio offers a unique combination of cost, effectiveness and versatility for long-haul communications. In recent years, computer technology and high-speed digital signal processing have enhanced the performance and reliability of HF communications systems, resulting in reduced operator involvement in establishing HF communications circuits.
At the same time, new technology has dramatically reduced the size and weight of HF radio equipment. Diverse capabilities, which formerly required separate pieces of equipment, are now combined and embedded into the radio transceiver itself.

2. Harris Corporation, RF Communications Division, designs, manufactures, and installs turnkey radio communications systems for worldwide government, military, and commercial markets. Here are some examples of how these HF systems come together in a modern communications network to meet complex communications needs.

3. Figure 11 shows a typical secure HF data transmission system, which can be used whenever it is necessary to transfer data securely between two points. The serial modem, which uses FEC coding, also provides real-time channel equalization and data interleaving for protection against fading, and automatic excision filters remove interference from up to four sources. The transmit modem data rate adjusts to the terminal data rate and is selected on the basis of an LQA (estimate of channel quality). The amount of coding (redundancy) used in the FEC varies as a function of the selected modem data rate. Thus, if poor channel quality is predicted, a relatively low data rate and a more powerful FEC code will be designated.

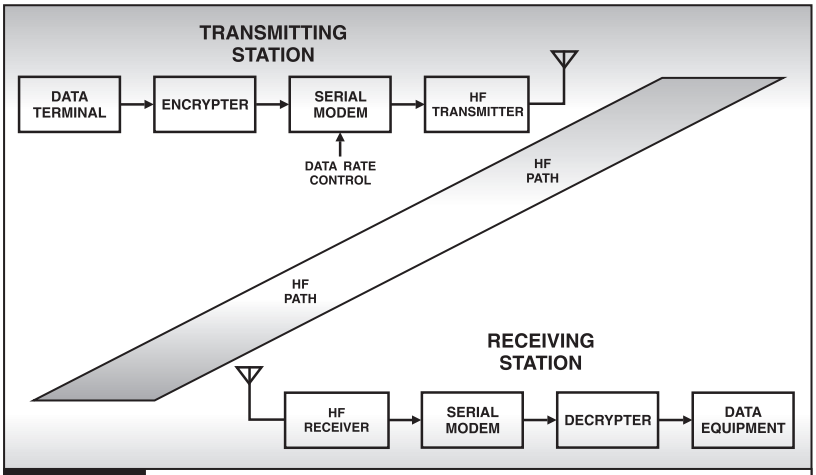

Figure 11 **Secure Data System**

4. A country-wide HF data communications system, which provides economical, long-range communications, is shown in Figure 12.

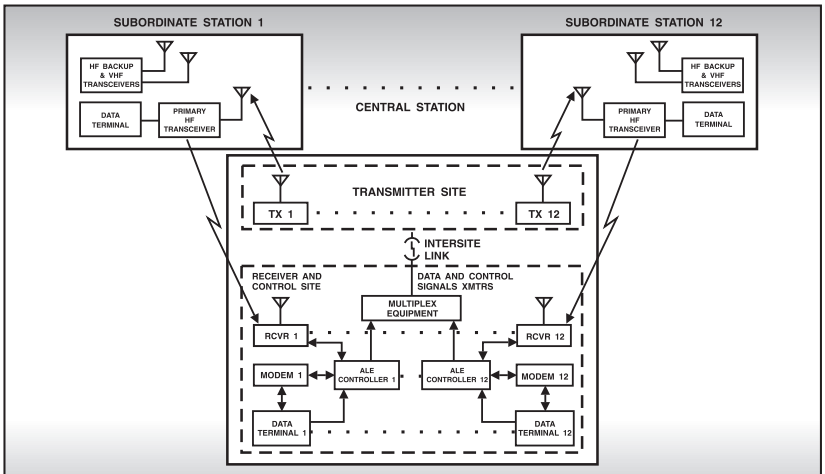

Figure 12 **Country-Wide HF Data Communications System**

The HF data communications system links a fixed central communications center and 12 subordinate stations located throughout the country. The system incorporates an ALE capability that offers fully automatic operation with unattended processing of incoming messages.

Each subordinate station has additional HF and VHF radios that provide voice and data communications to mobile stations in its vicinity. In the data communications mode, an ARQ message protocol is used for error detection and correction. The central station is a fixed installation with separate transmit and receive control sites. Intersite communications and control are via microwave or a landline link.

5. An HF radio link can extend the reach of a telephone network, as shown in Figure 13. The system operates much like the cordless telephone widely used in homes today, but covers hundreds of thousands of miles using HF radio. The HF telephone system enables users to place calls to and from mobile radio transceivers into the commercial switched telephone network or private subscriber telephone lines.

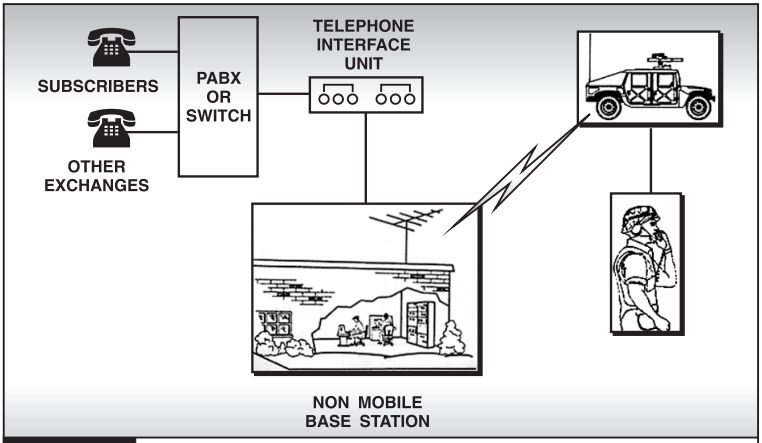

Figure 13 **HF Telephone System**

6. Calls from the field can be placed over HF, VHF, or UHF to anywhere in the world through the base station telephone switch or exchange. To initiate a call, the user enters a telephone number just as if the Remote Access Unit (RAU) were a telephone set connected directly to the base station telephone exchange.

7. At this point, the number dialed is transmitted through the RAU to the Telephone Interface Unit (TIU). As the TIU dials the digits and the telephone rings, call progress tones are heard by the mobile operator. In order to contact anyone in the field, a telephone user dials a telephone number (or the extension) to which the TIU is connected – from anywhere in the world. The call is automatically answered by the TIU and the user is connected directly with the field radio.

II. ELEMENTS OF RADIO SYSTEMS

CLASS ACTIVITY

ACTIVITY 1

Text 2.1: NOISE AND INTERFERENCE
Grammar: WAYS OF EXPPRESSING SUBJECT

Task 39. Study the ways of expressing subject in the English Sentence. Translate the sentences.

WAYS OF EXPRESSING SUBJECT (PARTS OF SPEECH)	**EXAMPLE**
1. A noun (in the common case)	Receiver noise comes from both sources.
2. A Gerund, a gerundial phrase or construction.	Combating noise and interference includes boosting the effective radiated power and providing a means for optimizing up.
3. A substantivised adjective or participle.	The wireless is disabled or not associated.
4. An infinitive, infinitive phrase or constructions.	To reduce collocation interference apply carefully orienting antennas.
5. “It” as a subject of the sentence.	It may be continuous (constant transmitting) or look-through (transmit and when signal to be jammed is present).

Task 40. Find the subject in the English sentence. Pay attention to the ways of expressing it in the Russian equivalent.

1. External noise levels greatly exceed internal receiver noise over much of the HF band.	Уровни внешних шумов сильно превышают внутренние шумы приемника на большей части ВЧ-диапазона.
2. Lighting is the main natural source of noise	Молния – это основной (природный) источник шума.
3. It may be a deliberate attempt on the part of an adversary to disrupt an operator's ability to communicate.	Это может быть предумышленной попыткой злоумышленника помешать оператору вести связь.
4. Grounding and shielding of the radio equipment and filtering of AC power input lines are techniques used by engineers to suppress EMI.	Заземление и экранирование радиооборудования и фильтрация входных линий переменного тока – это способы, используемые инженерами для подавления электромагнитных помех.
5. It is uniformly distributed over the HF spectrum, but does not affect performance below 20 MHz.	Он равномерно распространяется по ВЧ-спектру, но никак не влияет на производительность ниже 20 МГц.

Task 41. Study the sentences where the following words and word combinations are used.

1. Receiver noise and interference – *шум и интерференция приемника*

Receiver noise and interference come from both external and internal sources.

2. Signal-to-noise ratio (SNR) – *отношение сигнал/ шум*

Signal quality is indicated by signal-to-noise ratio (SNR), measured in decibels (dB).

3. Boosting – *повышение, увеличение*

Boosting the effective radiated power is in one of the techniques used by engineers in combating noise and interference.

4. Man-made noise – *индустриальная помеха, искусственно созданный шум*

Power lines, computer equipment, industrial and office machinery produce man-made noise.

5. Grounding and shielding – *заземление и экранирование*

Grounding and shielding of the radio equipment are important for EMI suppression.

Task 42. Match up the words with the definitions.

noise	jam
interference	earth fault
boosting	to choose
grounding	cancellation
shielding	artificial; industrial
to select	scaling up; increase, raise
suppression	shading; caging
man-made	static at radio wavelengths

Task 43. Skim the text from Task 44 and find key sentences in each paragraph.

Task 44. Read the following text carefully and try to understand the content of the text.

TEXT 2.1:

NOISE AND INTERFERENCE

1. Receiver noise and interference come from both external and internal sources. External noise levels greatly exceed internal receiver noise over much of the HF band. Signal quality is indicated by signal-to-noise ratio (SNR), measured in decibels (dB). The higher the SNR, the better the signal quality. Interference may be inadvertent, as in the case of the

pilot's call to the tower. Or, it may be a deliberate attempt on the part of an adversary to disrupt an operator's ability to communicate.

2. Engineers use various techniques to combat noise and interference, including: (1) boosting the effective radiated power, (2) providing a means for optimizing operating frequency, (3) choosing a suitable modulation scheme, (4) selecting the appropriate antenna system, and (5) designing receivers that reject interfering signals. Let's look at some of the more common causes of noise and interference.

3. Lightning is the main atmospheric (natural) source of noise. Atmospheric noise is the highest during the summer and greatest at night, especially in the 1- to 5-MHz range. Average values of atmospheric noise, as functions of time of day and season, have been determined for locations around the world, and are used in predicting HF radio system performance. Another natural noise source is galactic or cosmic noise, generated in space. It is uniformly distributed over the HF spectrum, but does not affect performance below 20 MHz.

4. Power lines, computer equipment, and industrial and office machinery produce man-made noise, which can reach a receiver through radiation or by conduction through power cables. This type of man-made noise is called electromagnetic interference (EMI) and it is the highest in urban areas. Grounding and shielding of the radio equipment and filtering of AC power input lines are techniques used by engineers to suppress EMI.

5. At any given time, thousands of HF transmitters compete for space on the radio spectrum in a relatively narrow range of frequencies, causing interference with one another. Interference is most severe at night in the lower bands at frequencies close to the MUF. The HF radio spectrum is especially congested in Europe due to the density of the population.

6. A major source of unintentional interference is the collocation of transmitters, receivers, and antennas. It's a problem on ships, for instance, where space limitations dictate that several radio systems be located together. For more than 30 years, Harris RF Communications has designed and implemented high-quality integrated shipboard communications systems that eliminate problems caused by collocation. Ways to reduce collocation interference include carefully orienting antennas, using receivers that won't overload on strong, undesired signals, and using transmitters that are designed to minimize intermodulation.

7. Deliberate interference, or jamming, results from transmitting on

operating frequencies with the intent to disrupt communications. Jamming can be directed at a single channel or be wide band. It may be continuous (constant transmitting) or look-through (transmitting only when the signal to be jammed is present). Modern military radio systems use spread-spectrum techniques to overcome jamming and reduce the probability of detection or interception. Spread-spectrum techniques are techniques in which the modulated information is transmitted in a bandwidth considerably greater than the frequency content of the original information. Signals from a transmitter reach the receiver via multiple paths (figure 14). This causes fading, a variation in average signal level because these signals may add or subtract from each other in a random way.

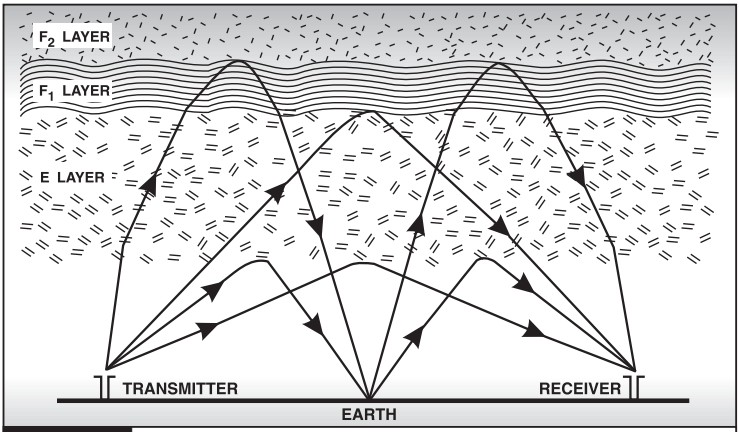

Figure 14 **Multipath Reception**

Task 45. Fill in the gaps with the correct variants:

1. Receiver …… and interference come from both external and internal sources.

a) signal b) noise c) grounding

2. External noise …..... greatly exceed internal receiver noise over much of the HF band.

a) receiver b) level c) sources

3. Lighting in the main …… of noise.

a) interference b) source c) level

4. Power lines, computer equipment industrial and office machinery produce …….. noise.

a) natural b) artificial c) man made

5. Grounding and …… of the radio equipment and filtering of AC power input lines are techniques used by engineers to suppress EMI.

a) each b) shielding c) collocation

Task 46. Match up given titles to each paragraph of the TEXT 2.1:

1. Quality of a signal.
2. Various techniques to combat noise and interference.
3. Atmospheric noise.
4. Electromagnetic interference.
5. Collocation of transmitters.
6. Space noise.
7. Spread-spectrum techniques used to overcome jamming.

Task 47. Organizing your thoughts.

1. Where do receiver noise and interference come from?
2. What is a signal-to-noise ratio (SNR)?
3. What techniques do engineers provide to combat noise and interference?
4. When is the atmospheric noise highest?
5. How is man-made noise produced?
6. What do you know about unintentional interference?
7. What is a major source of unintentional interference?
8. What are the ways to reduce collocation interference?
9. What are the spread-spectrum techniques aimed at?
10. Why do radio engineers use spread-spectrum techniques in modern military radio systems?

Task 48. Sum up the TEXT 2.1 using the following plan:

1. External noise level.
2. Natural noise.
3. Interference and its problems.
4. Collocation problems.

ACTIVITY 2

Text 2.2: ELEMENTS OF RADIO SYSTEMS

Grammar: COMPOSITION OF NOUNS

Task 49. Form nouns of the following verbs:

a) verb + er, ier → noun

to transmit – transmitter
to amplify –
to transceive –
to ractify –
to transform –
to receive –
to control –

b) verb + tion → noun

to communicate – communication
to demodulate –
to absorb –

c) verb + ment → noun

to develop – development
to equip –

Task 50. Find nouns in the following English sentences. Pay attention to how they are formed.

1. The primary components in the HF radio systems fall into the groups: transmitters, receivers and antennas.
2. The resulting signal is converted to the frequency that is to be transmitted.
3. This process reduces interference with adjacent communications channels.
4. Receivers select a desired signal, amplify it to a suitable level.
5. At present lots of functions are performed digitally.

6. The filtered signal is converted to another frequency for further processing.

Task 51. Skim the following text and try to understand the subject-matter of the text.

TEXT 2.2:

ELEMENTS OF RADIO SYSTEMS

1. Now that you have an overview of how radio waves propagate, let's take a look at how they are generated. The primary components in an HF radio system fall into three groups: transmitters, receivers, and antennas. In many modern radio sets, the transmitter and receiver are contained in a single unit called a transceiver. In large, fixed systems, transmitting stations and receiving stations are customarily positioned at separate locations, often controlled from a remote third site.

2. Although transmitters may vary widely in their configuration, they all consist of an exciter and power amplifier. A simplified diagram of a typical HF transmitter is shown in Figure 15.

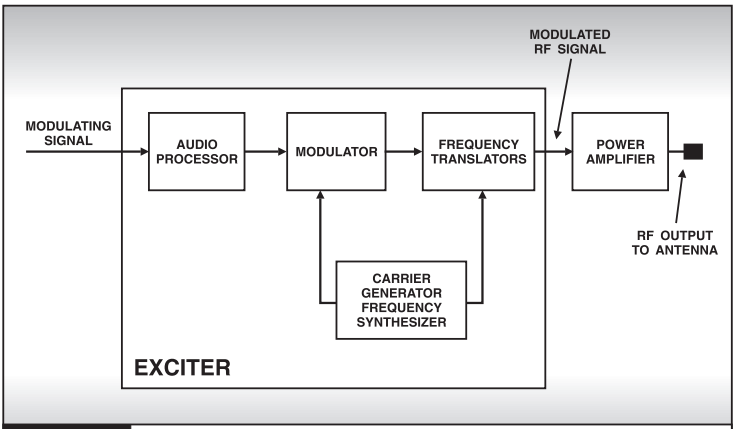

Figure 15 **Simplified Diagram of an HF Transmitter**

3. The exciter synthesizes a carrier, which has one of its properties – amplitude, frequency, or phase – modified (modulated) by a lower frequency signal derived from a source of information such as a microphone. The resulting signal is converted to the frequency that is to be transmitted. The power amplifier boosts the output power of the signal to the desired wattage for transmission before sending it through a cable to the transmitting antenna.

4. The transmitter may also contain filters that are used to "clean up" its

output. A bandpass filter removes noise, spurious signals, and harmonics generated in the exciter, or output frequency harmonics coming from the power amplifier. This process reduces interference with adjacent communications channels.

5. All modem HF receiving systems include an RF input filter/ amplifier, a series of frequency converters and intermediate frequency (IF) amplifiers, a demodulator, and a local oscillator frequency synthesizer (see figure 16). To function, the receiver selects a desired signal, amplifies it to a suitable level, and recovers the information through the process of demodulation, in which the original modulating signal is recovered from a modulating carrier. With contemporary radio equipment, many of these functions are performed digitally.

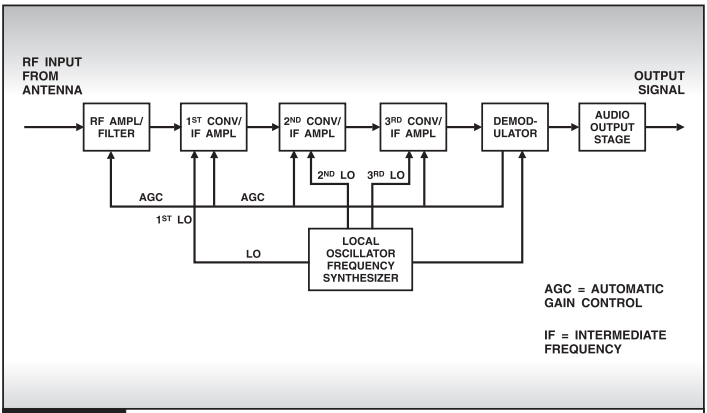

Figure 16 **Simplified Diagram of an HF Receiver**

6. In order to filter out noise and undesired signals, the RF input stage sometimes incorporates a tunable preselector (a bandpass filter). The filtered signal is then amplified and converted to another frequency for further processing.

7. But the filtering process does not end here. Typically, the received signal is filtered and amplified again at several different intermediate frequencies. The amplification provided in these stages is a variable that depends on the strength of the received signal.

8. In order to output voice or data, for example, the demodulator produces an audio-frequency (base-band) signal that interfaces with additional equipment. Also, because the strength of the input signal may not be constant, the demodulator stage produces a voltage proportional to the level of the RF input signal. To compensate for changes in the

signal, the voltage is fed back to the RF and IF amplifiers for automatic gain control (AGC), to maintain a constant input to the demodulator.

Task 52. Comprehension check:

1. What are the primary components in HF radio systems?

2. What does a transmitter consist of?

3. Does the power amplifier boost the output power of the signal to the desired wattage for transmission?

4. What is a resulting signal?

5. What are the transmitter filters used for?

6. To function, the receiver selects a desired signal, amplifies it to a suitable level, and recovers the information through the process of demodulation, doesn't it?

7. What is a tunable preselector used for?

8. Which function does a demodulator perform?

Task 53. Match up the words with the definition:

to transmit	Free transmission range
exciter	to get; to pick up a signal
amplifier	to transduce
bandpass	telecommunication provider
to receive	a device of increasing activity; feed element
to convert	a device for increasing strength
carrier	to transfer signals from one place to another

ACTIVITY 3

Text 2.3: ANTENNA CHARACTERISTICS AND PARAMETERS
Grammar: MODAL VERBS

Task 54. Study the meaning of English modal verbs in sentences.

Modal verbs	EXAMPLE
Can/may (мочь, возможно удастся)	Some antennas **can** provide a 50-ohm load to the transmitter. Maximum power **may** be transferred from the transmitter.
Must (должен, обязан)	Radio users **must** understand the radiation pattern of an antenna.
Should (должен, следует)	For ground ware propagation, the transmitting and receiving antennas **should** have the same polarization for best results.

Task 55. Find sentences with modal verbs in the English Sentences. Pay attention to their Russian equivalent.

1. The basic challenge in radio communications is to get the most power possible, that you may need to transmit signals.	Основной проблемой радиосвязи является получить наибольшую мощность, которая возможно вам потребуется для передачи сигналов.
2. Antennas can be connected directly to the transmitter.	Антенны могут быть подсоединены непосредственно к передатчику.
3. Radio users must understand the radiation pattern of an antenna for optimal original transmission.	Радиопользователи должны понимать диаграмму направленности излучения антенны для оптимальной передачи сигнала.
4. Polarization of the antenna need not be the same.	Поляризация антенн не должна быть одинаковой.

Task 56. Skim the following text and understand its subject- matter:

TEXT 2.3:

ANTENNA CHARACTERISTICS AND PARAMETERS

1. Some of the most commonly used terms to describe antennas are impedance, gain, radiation pattern, take-off angle, and polarization.

2. Every antenna has an input impedance, which represents the load to be applied to the transmitter. This impedance depends upon many factors, such as antenna design, frequency of operation, and location of the antenna with respect to surrounding objects.

3. The basic challenge in radio communications is finding ways to get the most power possible, where and when you need it, to generate and transmit signals. Most transmitters are designed to provide maximum output power and efficiency into a 50-ohm load. (OHM is a unit of measurement of resistance. Its symbol is Ω) Some antennas, such as log periodic antennas, can provide a 50-ohm load to the transmitter over a wide range of frequencies. These antennas can generally be connected directly to the transmitter. Other antennas, such as dipoles, whips, and long-wire antennas, have impedances that vary widely with frequency and the surrounding environment. In these cases, an antenna tuner Ohm coupler is used. This device is inserted between the transmitter and antenna to modify the characteristics of the load presented to the transmitter so that maximum power may be transferred from the transmitter to the antenna.

4. The gain of an antenna is a measure of its directivity – its ability to focus the energy it radiates in a particular direction. The gain may be determined by comparing the level of signal received from it against the level that would be received from an isotropic antenna, which radiates equally in all directions. Gain can be expressed in dB; the higher this number, the greater the directivity of the antenna. Transmitting antenna gain directly affects transmitter power requirements. If, for example, an omnidirectional antenna was replaced by a directional antenna with a gain of 10 dB, a 100-watt transmitter would produce the same effective radiated power as a 1-kW transmitter and omnidirectional antenna.

5. In addition to gain, radio users must understand the radiation pattern of an antenna for optimal signal transmission. Radiation pattern is determined by an antenna's design and is strongly influenced by its location with respect to the ground. It may also be affected by its proximity to nearby objects such as buildings and trees. In most

antennas, the pattern is not uniform, but is characterized by lobes (areas of strong radiation) and nulls (areas of weak radiation).

These patterns are generally represented graphically in terms of plots in the vertical and horizontal planes (figure 17), which show antenna gain as a function of elevation angle (vertical pattern) and azimuth angle (horizontal plot). The radiation patterns are frequency dependent, so plots at different frequencies are required to fully characterize the radiation pattern of an antenna.

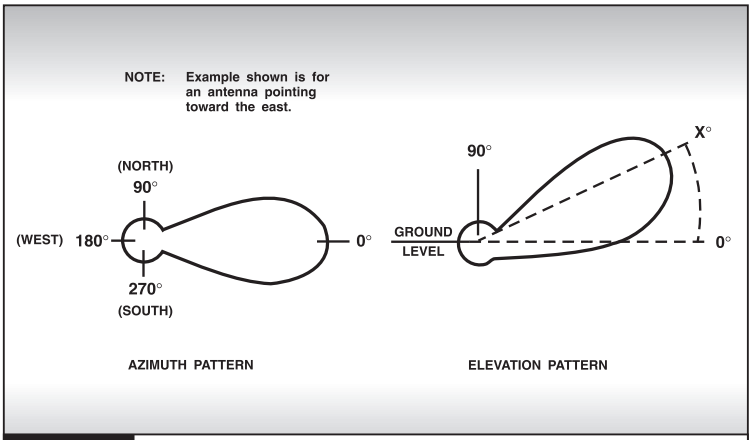

Figure 17 **Antenna Radiation Patterns**

6. In determining communications range, it is important to factor in the take-off angle, which is the angle between the main lobe of an antenna pattern and the horizontal plane of the transmitting antenna. Low take-off angles are generally used for long-haul communications; high take-off angles are used for shorter-range communications.

7. For ground wave propagation, the transmitting and receiving antennas should have the same polarization for best results. For sky wave propagation, the polarization of the antennas need not be the same, since the polarization of the signal will change during ionospheric refraction.

Task 57. Study the following sentences. Cover one part and translate from Russian into English, from English into Russian. Check up:

1. Some of the most commonly used terms to describe antennas are impedance, gain, radiation pattern, take-off angle, and polarization.	Некоторые из часто используемых терминов описания антенн – это импеданс, коэффициент усиления, диаграмма излучения, угол помех и поляризация.
2. Most transmitters are designed to provide maximum output power and efficiency into a 50-Ohm load.	Большинство передатчиков сконструированы так, чтобы обеспечить максимальную мощность и эффективность при нагрузке 50 Ом.
3. The gain of antenna is a measure of its directivity.	Усиление антенны – это мера ее направленности.
4. In determining communications range, it is important to factor in the take-off angle, which is the angle between the main lobe of an antenna pattern and the horizontal plane of the transmitting antenna.	При определении диапазона связи важно принимать во внимание угол помех, который является углом между главным лепестком диаграммы направленности антенны и горизонтальной плоскостью передающей антенны.

Task 58. Answer the following questions:

1. What are the most commonly used terms to describe antennas?

2. What does the impedance depend upon?

3. What is a unit of measurement of resistance?

4. What is the main challenge in radio communications?

5. Directivity is an ability to focus the energy the antenna radiates in a particular direction, isn't it?

6. What do you know about the gain of antenna?

7. Is a radiation pattern of an antenna characterized by lobes and nulls?

8. Are lobes areas of weak or strong radiation?

9. Why should transmitting and receiving antennas have the same polarization for best results?

Task 59. Match up the words with their definitions.

gain	emission of energy
impedance	A property of volume; effective power
radiation	a property of waves that describes the direction of electromagnetic field or various oscillations
output power	opposition in an electrical circuit to the blow of an alternating current
polarization	the amount of increase in signal power or voltage or current expressed as the ratio of output to input

Task 60. Which of the following do you think is true (T) or false (F)?

1. Some of the most commonly used terms to describe antennas are impedance, gain, radiation pattern, take-off angle and polarization.

2. The impedance depends upon take-off angle.

3. All antennas are connected directly to transmitters.

4. The gain of the antenna is a measure of load.

5. Transmitting antenna gain directly affects transmitter power requirements.

6. Radiation pattern is not determined by antennas design.

7. Take-off angle is the angle between the main lobe of antenna pattern and the horizontal plane of the transmitting antenna.

ACTIVITY 4

Text 2.4: TYPES OF ANTENNAS
Grammar: ARTICLES

Task 61. Study the types of articles.

The types of articles	EXAMPLE
The indefinite article	**a, an** There is a countless variety of antennas used in HF communications. An inverted vee produces a communication of horizontal and vertical radiation.
The definite article	**the** One of the most versatile types of HF antenna is the half-wave dipole. The radiation pattern can change dramatically as a function of its distance above the ground.

Task 62. Fill in the proper articles.

1. There is __ great variety of antennas used in mobile phones.
2. __ typical vertical whip radiation pattern is shown in __ figure.
3. __ reflector consists of ___ second vertical whip. ___Reflector can add directivity to ___ radiation pattern of___ whip.
4. In___figure you can see___center-fed horizontal dipole antenna.

Task 63. Read the following text and translate using a dictionary:

TEXT 2.4:

TYPES OF ANTENNAS

1. There is a countless variety of antennas used in HF communication. We'll focus here on just some of the more common types.

2. The vertical whip antenna is usually adequate for ground wave circuits, since it is omnidirectional, has low take-off angles, and is vertically polarized. A typical vertical whip radiation pattern is shown in figure 18. A reflector, consisting of a second vertical whip, can add directivity to the radiation pattern of a whip.

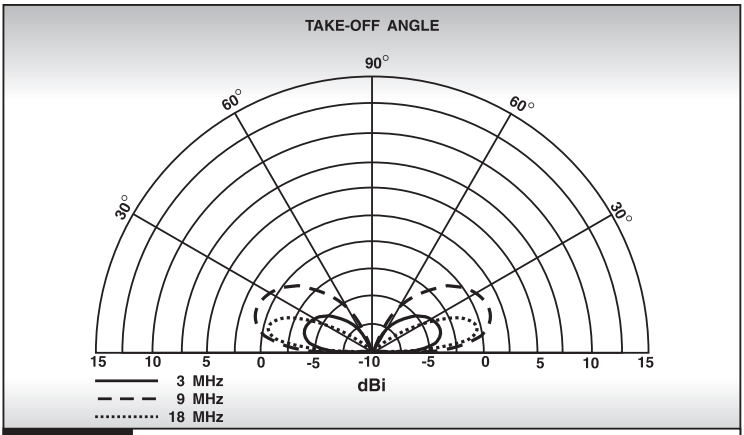

Figure 18 **Vertical Whip Radiation Pattern**

3. One of the most versatile types of HF antenna is the half-wave dipole, which is basically a length of wire equal to one-half the transmitting wavelength.

The dipole can be oriented to provide either horizontal or vertical (center-fed) polarization. Figure 19 shows a center-fed horizontal dipole antenna.

The radiation pattern can change dramatically as a function of its distance above the ground. Figure 20 shows the vertical radiation pattern of a horizontal dipole for several values of its height (in terms of transmitting wavelength) above the ground.

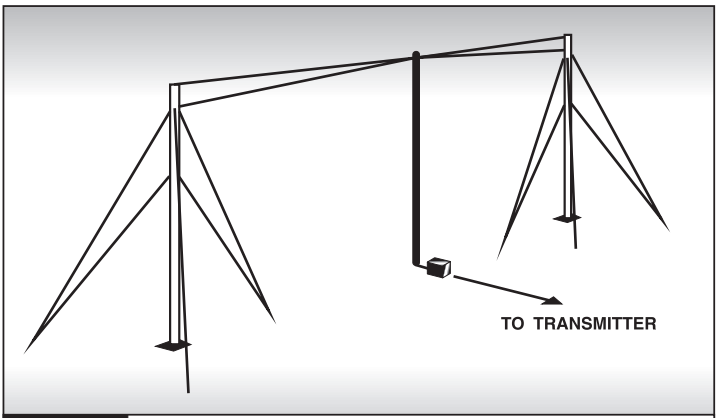

Figure 19 **Center-Fed Horizontal Dipole Antenna**

4. A vertical dipole can often be used effectively on ships or vehicles. An inverted vee (sometimes called a “drooping dipole”) produces a combination of horizontal and vertical radiation with omnidirectional coverage. See figure 21.

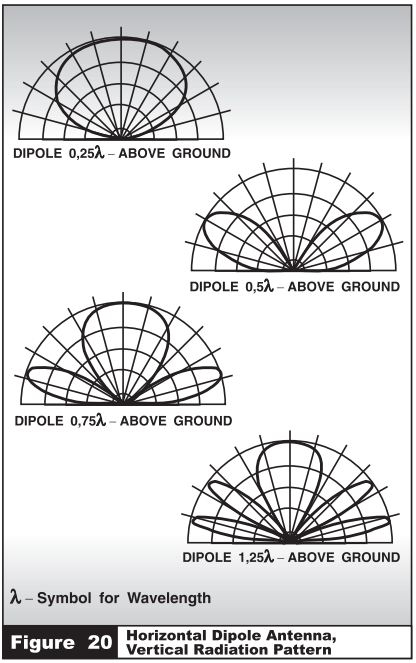

Figure 20 **Horizontal Dipole Antenna, Vertical Radiation Pattern**

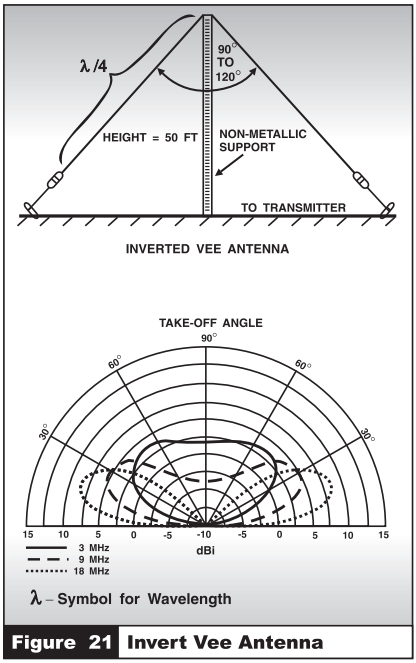

Figure 21 **Invert Vee Antenna**

5. Directional antennas range from simple single-wire configurations like the inverted vee to elaborate multi-wire arrays, including horizontal and vertical log periodic systems (see figure 22). Directional antennas are often used in point-to-point links. In systems requiring point-to- point communications to widely dispersed stations, rotatable directional antennas maybe used.

6. Sky wave communications between relatively closely spaced stations may require antennas specially designed for this purpose. These near vertical incidence sky wave (NVIS) antennas have a very high take-off angle, radiating RF energy nearly straight up. The radio waves refract downward to the earth in a circular pattern. NVIS antennas provide omnidirectional coverage out to about 600 km.

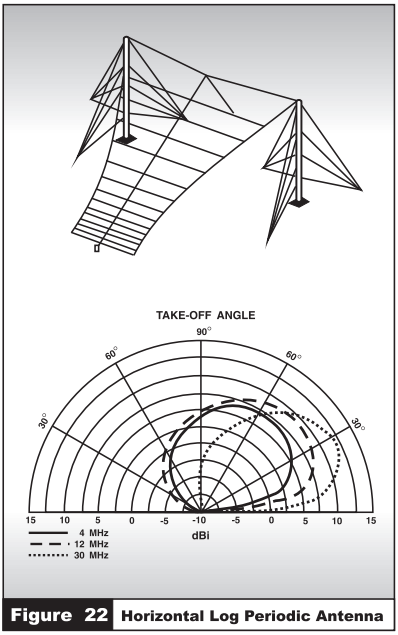

Figure 22 **Horizontal Log Periodic Antenna**

Task 64. Comprehension check:

1. How many antennas are there?
2. What is the vertical whip type of antenna?
3. Which of the most versatile types of HF antennas do you know?
4. Where can a vertical dipole be used?

5. What do you know about directional antennas?

6. Are the directional antennas often used in point-to-point links?

7. Which functions do sky wave communications perform?

8. The radio waves refract downward to the earth in a circular pattern, don't they?

Task 65. Study the sentences and practise in the translation with your partner.

1. The vertical whip antenna is usually adequate for ground wave circuits since it is omnidirectional.	Вертикальная штыревая антенна обычно подходит для варианта с наземными волнами, т.к. она всенаправленная.
2. The dipole can be oriented to provide either horizontal or vertical (centre-fed) polarization.	Дипольная антенна может быть ориентирована для обеспечения либо горизонтальной, либо вертикальной (по центру) поляризации.
3. The radiation pattern can change dramatically as a function of its distance about the ground.	Диаграмма направленного излучения может сильно изменяться в зависимости от расстояния до земли.
4. An inverted vee (sometimes called a "drooping dipole") produces a combination of horizontal and vertical radiation with omnidirectional coverage.	Антенна "перевернутая V" (иногда называемая "падающая дипольная антенна") производит комбинацию горизонтального и вертикального излучения, действующего по всем направлениям.
5. Directional antennas range from simple single wire configurations like the inverted vee.	Направленные антенны представляют собой простые одно проводные конфигурации, как "перевернутая V".
6. Sky waves communications between relatively closely spaced stations may require antennas specially designed for this purpose.	Для связи на отраженной волне между относительно близкими станциями могут потребоваться антенны, специально разработанные для этой цели.

Task 66. Fill in the gaps with proper words:

1. The vertical ..... antenna is usually ..... for ground wave.....
2. A typical ..... whip radiation ..... is shown in figure 18.
3. The radiation ..... can change dramatically as a function of its distance above the ground.
4. A vertical ..... can be used effectively on ships or.....
5. Directional antennas ..... single wire ..... like the inverted vee.
6. Sky wave ..... between relatively closely ..... may require antennas specially ..... for this purpose.

Task 67. Sum up the text using the following plan:

1. Antennas used in HF communication.
2. Vertical whip antenna and its functions.
3. Operations of half-wave dipole.
4. Directional antennas.
5. Sky wave communications.

ACTIVITY 5: VOCABULARY WORK AND DISCUSSION

Task 68. Explain the following words and word combinations:

Noise, interference, bandpass, carrier, to transmit, to provide, to select, to interfere.

Task 69. Translate the following sentences into Russian.

1. External noise levels greatly exceed internal receiver noise over much of the HF band.

2. Receiver noise and interference come from both external and internal sources.

3. A bandpass filter removes noise.

4. The resulting signal is converted to the frequency that is to be transmitted.

5. To function, the receiver selects a desired signal.

6. The amplification provided in these stages is variable and depends on the receiver signal.

Task 70. For the words given in A column find the Russian equivalent in B column.

A	B
exciter	выбирать
amplifier	возбудитель
carrier	вмешиваться
to interfere	полоса пропускания
to select	обеспечивать
noise	усилитель
to provide	носитель
bandpass	шум

Task 71. Define the meanings of the given words using English-English dictionary. The first example is given to you.
Pattern:
To transmit – to transfer from one place or person to another.

To amplify, to function, sky wave communication, to encode a message

Task 72. Here are some words you may find difficult in the following sentences which have several meanings. Decide which meaning is the correct one in the given sentences.

1. ..... is a man made source of the noise.
    1) lighting
    2) automobile traffic
    3) bird singing

2. Power lines, computer equipment, industrial and office machinery produce industrial.....
    1) results
    2) noise
    3) level

3. The resulting signal is..... to the frequency that is to be transmitted.
    1) transferred
    2) converted
    3) selected

4. Antennas can be ..... directly to the transmitter.
    1) joined
    2) connected
    3) applied

5. Most transmitters are designed ..... maximum output power.
    1) to receive
    2) to select
    3) to provide

Task 73. Try to find the meaning of each of the following acronyms using a glossary.
Example:
SNR – Signal-to-Noise Ratio

dB, FM, NVIS, LPD, AVS, SKMM, RF, EMI.

Task 74. Choose the best variant to complete each sentence using acronyms:

Pattern:
Signal quality is indicated by (SNR, HF, dB). Signal quality is indicated by signal-to-noise ratio (SNR, HF, dB).

See keys at the end of the Activity V.

1. Signal-to-noise ratio is measured in (MHz, dB, Ohm).
2. A man-made noise in called (FM, HF, EMI)
3. All modem high frequency receiving systems include (RF, IF, EM).
4. (NVIS, LPD, AVS) antennas have a very high take-off angle, radiating radio frequency energy nearly straight up.

DISCUSSION

In groups of four discuss the following problems. Share your answers with the whole group.

1) Analyze figure 14 and explain the techniques used by engineers in combination noise and interference.

2) What is signal-to-noise ratio? Define the problem.

3) Analyze the main elements of a radio system.

4) Recommend your ways of designing some new types of antennas.

Keys: 1. SNR; 2. dB; 3. EMI; 4. RF; 5. NVIS

OUTCLASS ACTIVITY

Task 75. Read the text and give the written translation using your dictionary and paying attention to Gerundial Constructions and the Gerund.

TEXT 1:

SECURING COMMUNICATIONS

1. COMSEC uses scrambling or cryptographic techniques in order to make information unintelligible to people who do not have a need to know or who should not know. We'll differentiate here between cryptographic or ciphering techniques applied to digital signals and scrambling techniques applied to analog signals.

2. Cryptography is the process of encrypting (translating) information into an apparently random message at the transmitter and then deciphering the random message by decryption at the receiver.

3. Historically, sensitive information has been protected through the use of codes. The sender would manually encode the messages before transmission and the recipient would manually decode the messages upon receipt. Today's electronic technologies allow the coding/decoding process to occur automatically.

4. The process involves using a mathematical algorithm, coupled with a key, to translate information from the clear to the encrypted state. If sensitive information is transmitted without the protection of cryptography

and the information is intercepted, it would require little effort or resources to understand the transmittal. The US Government has established standards for the degree of protection required for different levels of classified and sensitive information.

5. In voice communications systems that do not require extremely high security, you can protect against casual eavesdropping by scrambling. Scrambling, as an analog COMSEC technique, involves separating the voice signal into a number of audio sub-bands, shifting each sub-band to a different audio frequency range, and combining the resulting sub-bands into a composite audio output that modulates the transmitter. A random pattern controls the frequency shifting. The technique of scrambling the pattern is similar to sending a message with a decoder ring, like the ones sometimes found in children's cereal boxes. You can, for example, designate that the letter ñ be ciphered as g, a as n, and t as w, so that when you receive the message "gnw", you decode it as "cat". Descrambling occurs at the receiver by reversing the process. Harris' Analog Voice Security (AVS) allows for easy entry into the communications net because it does not require synchronization with other stations.

6. In digital encryption the data, which may be digitized voice, is reduced to a binary data stream. The cryptographic engine creates an extremely long, non-repeating binary number stream based on a traffic encryption key (DES). The data stream is added to the cryptographic stream, creating the encrypted data, or cipher text. A binary stream created in this fashion is inherently unpredictable; it also provides a very secure method of protecting information. On the other hand, all analog signals are more predictable and thus less secure.

7. The data encryption strength, which is the degree of difficulty in determining the message content, is a function of the complexity of the mathematical algorithm coupled with the key. The key is a variable that changes the resynchronization of the mathematical algorithm. Protection of the key is vital. Even if an unwanted organization gains access to the encrypted information and has the algorithm, it is still impossible to decrypt the information without the key. The US Government has developed rigorous key management procedures to protect, distribute, store, and dispose of keys.

8. In the past, keys were manually loaded into a cryptographic device by using a paper tape, magnetic medium, or plug-in transfer device. Creation and secure delivery of keys to each user were significant problems in both logistics and record keeping.

9. One type of key management system also used in the commercial sector is public key cryptography. Under this standard, each user generates two keys.

10. In a network using this public key system, two-way secure communications are possible among all network users. This is called an asymmetrical key system. The alternative is a symmetric key system, in which the same key encrypts and decrypts data. Because both the originator and all recipients must have the same 4 keys, this system offers the highest levels of security.

Task 76. Read the text 2 and sum it up:

TEXT 2: TRANSEC

1. TRANSEC employs a number of techniques to prevent signal detection or jamming of the transmission path. These techniques include hiding the channel or making it a moving target.

2. Low Probability of Detection (LPD) systems transmit using very low power or spread the signal over a broad bandwidth so that the natural noise in the environment masks the signal.

3. A related strategy, known as Low Probability of Intercept (LPI), involves transmitting signals in short bursts or over a wide bandwidth to reduce on-the-air time.

4. The most commonly used TRANSEC technique is frequency hopping. In this system, the transmitter frequency changes so rapidly that it is difficult for anyone not authorized to listen in or to jam the signal. The receiver is synchronized so that it hops from frequency to frequency in a predetermined pattern in unison with the transmitter. Frequency hopping scatters the intelligence over several hundred discrete frequencies. A radio operator listening to one of these frequencies may hear a short “pop” of static. A broadband receiver could perhaps capture all of these little bursts; however, the task of picking these bursts out of the other natural and man-made bits of noise would be daunting, requiring a team of experts several hours just to reassemble a short conversation. Jamming one channel would have minimal impact on the hopping communicator. To effectively jam a frequency – hopping radio, most or all of the frequencies that the hopping communicator uses would have to be jammed, thus preventing the use of those frequencies as well. Harris’ AN/PRC-117, AN/PRC-138, and RF-5000 FALCON transceiver series of products are highly rated for their frequency-hopping capabilities.

5. Harris' RF Communications Secure Products Line is a preferred supplier of information security for the US Government and the US Department of Defense. It is a leader in the development and production of US Government and exportable security products. The NSA-endorsed WINDSTER Key Generator Module and SKMM (Standard Key Management Module) line of products has full OTAR capabilities and meets NSA's rigorous Commercial COMSEC Endorsement Program requirements.

6.Harris' COMSEC/TRANSEC Integrated Circuit (CTIC) and COMSEC/ TRANSEC Integrated Circuit/DS-101 Hybrid (CDH) provide system embedders and US Government customers protection of highly classified information using state-of-the-art TRANSEC/COMSEC techniques. The company also provides a comprehensive line of secure products for the export market.

III. RADIO COMMUNICATIONS PROCESSING FUNCTIONS

CLASS ACTIVITY

ACTIVITY 1

Text 3.1: RADIO COMMUNICATIONS PROCESSING FUNCTIONS
Grammar: THE INFINITIVE

Task 77. Study the functions of the Infinitive in the English sentences:

THE FUNCTIONS OF THE INFINITIVE	EXAMPLE
Object	It is important <u>to receive</u> a signal at the high frequency stage and process it with numerical algorithms.
Purpose Clause	Innovative techniques such as sub-sampling are used <u>to process</u> bandpass signals of small to moderate bandwidth.

Task 78. Find the Infinitive in the following English sentences. Pay attention how they are expressed in the Russian equivalent.

1. A new approach is now becoming popular – one that employs digital electronics to implement most of the analog signal processing functions of the radio.	В настоящее время, все большее распространение получает иной подход, связанный с использованием цифровых электронных устройств для выполнения функций обработки аналогового сигнала в радиоприборах.

2. It is no longer uncommon to sample a received signal at the intermediate frequency stage.	Выбор принимаемого сигнала на стадии промежуточной частоты больше не воспринимается как нечто необычное.
3. The hardware currently available to implement DSP algorithms for all stages of the radio system is still limited in speed, accuracy and flexibility.	Существующее в настоящее время аппаратное обеспечение, позволяющее использовать алгоритмы обработки цифрового сигнала во всех элементах радио устройства, все еще обладает недостаточной скоростью, точностью и гибкостью.
4. Innovative techniques such as sub-sampling are used to process bandpass signals of small to moderate bandwidth.	Усовершенствованные технологии, такие как дополнительная проверка, используются для обработки сигналов, проходящих по диапазону малой или средней частоты.

Task 79. Study the sentences and memorize the given words and word combinations. Translate the sentences without using a dictionary:

1. approach – *подход, метод*
to implement – *внедрять, использовать*

A new approach is now becoming popular – one that employs digital electronics to implement most of the analog signal processing functions in the radio.

2. design – *устройство, конструкция*
cost – *стоимость*

This evolution in radio system design is driven by the ever increasing speed and decreasing cost of microprocessors.

3. hardware – *аппаратное обеспечение*
intermediate – *промежуточный*

A specialized digital signal processing hardware processes the signal received at the intermediate frequency stage.

4. conversion – *преобразование*
filtering – *фильтрование*

The DSP hardware performs a variety of operations on the signal including down conversion, demodulation and filtering.

5. framework – *остов, каркас, структура*
software – *программное обеспечение*

The mathematics of digital signal processing provides the framework for the design of software radio algorithms.

6. accuracy – *точность*
flexibility – *гибкость*

The currently available hardware that implements DSP algorithms for all stages of the radio system is still limited in speed, accuracy and flexibility.

7. device – *устройство, приспособление*
frequency – *частота*

As digital electronic devices increased in speed, DSP was soon applied to signal processing functions performed at high frequencies.

8. coherent – *последовательный, когерентный (синфазный)*
stage – *стадия, фаза, этап*

Functions such as IF bandpass filtering, automatic gain control (AGC) and coherent modulation and demodulation are typically required at this stage.

9. innovate – *новый, усовершенствованный*
moderate – *ослаблять, смягчать*

Innovative techniques are used to process bandpass signals of small to moderate bandwidth in the absence of a sufficiently high speed processing capability.

10. challenge – *сложная задача, вызов, проблема*
spectrum – *спектр*

Military radio systems pose a notable challenge because of the wide bandwidth characteristics of spread spectrum modulation.

Task 80. Read the following text carefully and try to understand the content of the text.

TEXT 3.1:

RADIO COMMUNICATIONS PROCESSING FUNCTIONS

1. Until recently radio transmitters and receivers were almost exclusively implemented with analog electronic components. However, a new approach is now becoming popular – one that employs digital electronics to implement most of the analog signal processing functions in the radio. This evolution in radio system design is driven by the every increasing speed and decreasing cost of microprocessors and high performance analog-to-digital (ADC) and digital-to-analog (DAC) converters. It is no longer uncommon to sample a received signal at the intermediate frequency (IF) stage and process the signal with numerical algorithms using a specialized digital-signal processing (DSP) hardware. The DSP hardware performs a variety of operations on the signal including down conversion, demodulation, and filtering; all of which are inherently continuous-time (i.e., analog) processes.

2. The mathematics of digital signal processing provides the framework for the design of software radio algorithms, while modern high speed digital electronic components make real time implementation of these algorithms possible. However, the hardware currently available to implement DSP algorithms for all stages of the radio system is still limited in speed, accuracy and flexibility. Initially, digital signal processing was used only for base-band waveform processing.

As digital electronic devices increased in speed, DSP was soon applied to signal processing functions performed at higher frequencies – e.g., the final IF stage in a radio receiver. Functions such as IF bandpass filtering, automatic gain control (AGC), and coherent modulation and demodulation are typically required at this stage.

In the absence of a sufficiently high speed processing capability, innovative techniques such as sub-sampling are used to process bandpass signals of small to moderate bandwidth. This has allowed the boundary between analog and digital processing to be pushed as far up the signal path towards the antenna as permitted by physical electronic devices.

For most types of moderate data rate communications – on the order of 100 kB/s or less – bandwidth is not a serious barrier to DSP techniques. However, military radio systems pose a notable challenge because of the wide bandwidth characteristics of spread spectrum modulation.

Task 81. Fill in the gaps with the correct variants:

1. A new . . . . . is now becoming popular – one that employs digital electronics to implement most of the analog signal processing functions in the radio.

a) trend b) approach c) variant d) option

2. It is no longer . . . . . to sample a received signal at the intermediate frequency stage.

a) possible b) conventional c) admissible d) uncommon

3. The mathematics of digital signal processing provides the . . . . . for the design of software radio algorithms.

a) system b) arrangement c) framework d) theory

4. Functions, such as IF bandpass filtering, automatic gain control and . . . . . modulation and demodulation are typically required at this stage.

a) coherent b) successive c) alternating d) simultaneous

5. In the absence of a sufficiently high speed processing capability . . . . . techniques, such as sub-sampling are used to process bandpass signals.

a) outdated b) special c) universal d) innovative

Task 82. Find key sentences in each paragraph and underline them.

Task 83. Match up the given titles to each paragraph of TEXT 3.1:

1. Today's analog signal processing functions of the radio.

2. Implementation of digital algorithms for all stages of radio systems.

3. Innovative techniques used for processing band pass signals.

4. A challenge of military radio systems.

Task 84. Match up the words with their definitions.

component	a problem, difficult to cope with; difficulty
design	a line along which something moves
variety	a quality of being able to adapt to different conditions and circumstances; an ability of the spectrum regulatory framework to facilitate and adapt
to moderate	a part/ unit/ element of a complete thing
challenge	speed
flexibility	the programming of a computer
absence	a number or group of different things
rate	the general arrangement of something; circuitry
path	the state of being away from a place; lack of
software	to inhibit

Task 85. Organizing your thoughts. Answer the following questions:

1. What kind of evolution is now taking place in radio systems?

2. What operations does the DSP hardware perform?

3. Which parameters is the DSP hardware limited in?

4. What operations are used at the final IF stage in a radio receiver?

5. What is used to process bandpass signals in the absence of a sufficiently high speed processing capability?

6. What techniques are applied in the absence of a sufficiently high speed processing capability?

7. Why do military radio systems pose a notable challenge?

Task 86. Sum up the text using the following plan:

1. Operations of DSP hardware.
2. Operations required at the final IF stage in a radio receiver.
3. Techniques applied in the absence of a sufficiently high speed processing capability.
4. Challenge of military radio systems.

ACTIVITY 2

Text 3.2: SOFTWARE RADIO
Grammar: THE GERUND

Task 87. Study the functions of the Gerund in the English sentences:

THE FUNCTION OF THE GERUND	EXAMPLE
Attribute	The essential concept of software radio is that most of the operations processing analog signals transmitted with digital hardware.
Adverbial modifier	The ability to adapt the radio to its environment by changing filters, changing modulation schemes, switching channels, using different protocols and dynamically assigning channels and capacity are features which are impractical to deliver with hardware alone.
Object (direct and indirect)/ Adjunct	The motivation for implementing radios in software is that a highly flexible and reconfigurable communication system can be implemented for relatively low cost. In the software radio receiver the approach often used is to digitize an entire band and to perform processing of IF, base-band, bit stream and other functions completely in software.

Task 88. Find the Gerund in the following English sentences. Pay attention how it is expressed in the Russian equivalents.

1. Most of the analog signal processing operations of the radio transmitter and receiver are implemented with digital hardware using DSP techniques.	Большинство операций по обработке аналогового сигнала передатчиков и радиоприемников выполняются цифровой аппаратурой с использованием технологий обработки цифрового сигнала.
2. The signal processing requirements for military and commercial radio system easily exceed the processing speeds currently available in off-the-shelf DSP microprocessors.	Требования к обработке сигнала в военных и коммерческих радиосистемах заключаются в превышении скорости обработки существующих ЦПОС.
3. The ability to adapt the radio to its environment by changing filters, changing modulation schemes and switching channels are features which are impractical to deliver with hardware alone.	Способность регулировать работу радио в соответствии с окружающей его средой путем замены фильтров, изменение схем модуляции и переключения каналов – функции, которые невозможно выполнить, используя лишь аппаратное обеспечение.

Task 89. Skim the following text and try to understand the subject- matter of the text.

TEXT 3.2:

SOFTWARE RADIO

1. The essential concept of software radio is that most of the analog signal processing operations of the radio transmitter and receiver are implemented with digital hardware using DSP techniques. The placement of the receiver analog to digital converter (ADC) and the transmitter digital to analog converter (DAC) as close to the antenna as possible are distinguishing characteristics of the software radio.

In the software radio receiver, the approach often used is to digitize an entire band and to perform IF processing, base-band, bit stream and other functions completely in software. This approach requires the use of

high speed analog to digital converters and high speed DSP microprocessors. However, the signal processing requirements for military and commercial radio systems employing high data rate signals or spread spectrum modulation easily exceeds the processing speeds currently available in off-the-shelf DSP microprocessors. In this case, special purpose DSP hardware, application specific devices and field programmable gate arrays can play an important role.

2. The motivation for implementing radios in software is that a highly flexible and re-configurable communication system can be implemented for relatively low cost. The ability to adapt the radio lo its environment by changing filters, changing modulation schemes, switching channels, using different protocols and dynamically assigning channels and capacity are features which are impractical to deliver with hardware alone. Since the behavior of the software radio can be changed so easily, defining a particular architecture does not limit the radio to one specific function. Instead, multiple radio systems can share a common front-end analog radio tuner while having independent digital processing for each individual radio channel.

Task 90. Comprehension check:

1. What are distinguishing characteristics of the software radio?
2. Which functions can be performed in the software radio receiver?
3. How can the radio be adapted to its environment?

Task 91. Match the words with their definitions:

essential	to be greater than
band	storage/ memory size
to require	configuration; model; topology; geometry
to exceed	medium, media; software envelope
filter	most important
capacity	a range of frequencies
architecture	to reshape; to tune in
to reconfigure	to need
environment	mode changer; **convertrator**; chopper

ACTIVITY 3

Text 3.3: ADVANTAGES OF SPECIALIZED DIGITAL HARDWARE
Grammar: THE WAYS OF EXPRESSING THE ATTRIBUTE

Task 92. Study the ways of expressing the Attribute in the English sentences:

THE WAYS OF EXPRESSING THE ATTRIBUTE	EXAMPLE
Adjective	A conventional DSP micro-processor has only a single multiply accumulate stage.
Noun	ASIC technology offers the ability to design a custom architecture that is optimized for a particular application.
Noun Group	Many ASSPs may not be available instate of the art process technology.

Task 93. Skim the following text and try to understand the subject- matter of the text:

TEXT 3.3:

ADVANTAGES OF SPECIALIZED DIGITAL HARDWARE

1. When digital signal processing at wide bandwidths is required the radio designer turns to specialized hardware which can operate at much higher throughputs than is possible with a DSP microprocessor. These include application specific standard products (ASSP), application specific integrated circuits (ASIC), and field programmable gate arrays (FPGA).

2. Application Specific Standard Products (ASSP) such as FIR filters, correlators, and FFT processors, permit certain popular DSP algorithms or functions to be optimized in hardware at the cost of

flexibility. Use of ASSPs can significantly increase the device count and often presents special interface problems which can lead to further complications. Furthermore, due to a narrow range of applicability, many ASSPs may not be available in state of the art process technology.

3. When performance is a factor and product volume is high, many designers turn to ASIC technology. ASIC technology offers the ability to design a custom architecture that is optimized for a particular application. For example a conventional DSP microprocessor has only a single-multiply-accumulate (MAC) stage, so each filter tap must be executed sequentially. An ASIC implementation of a DSP algorithm, on the other hand, might have multiple parallel multiply- accumulate (MAC) stages. When comparing the performance of the ASIC versus the DSP microprocessor it becomes apparent that the DSP microprocessor offers slow speed but maximum flexibility (due to programmability) while the ASIC provides high speed with minimal flexibility. Between these two extremes lies the field programmable gate array.

Task 94. Answer the following questions:

1. In which case does the radio designer turn to specialized hardware?

2. What applications of ASSP do you know?

3. How many stages does a conventional DSP microprocessor have?

4. Which conclusion can we make, comparing the performance of the ASIC versus the DSP microprocessor?

Task 95. Say whether the following statements are true (T) or false (F):

1. When digital signal processing at wide bandwidths is required, the radio designer turns to specialized hardware.
2. Application Specific Standard Product can eliminate all interface problems.
3. A conventional DSP microprocessor has two stages.
4. The ASIC provides high speed with minimal flexibility.
5. When performance is a factor and product volume is high, many designers don't turn to ASIC technology.
6. The DSP microprocessor offers high speed and max. flexibility.

ACTIVITY 4

Text 3.4: MILITARY RADIO SIGNAL PROCESSING REQUIREMENTS
Grammar: THE FUNCTION OF THE NOUN

Task 96. Study the function of the Noun in the English sentences:

THE FUNCTION OF THE NOUN	EXAMPLE
Subject	Military communication systems often require the use of spread spectrum techniques.
Attribute	Wide bandwidth signals are present at the output stage of the transmitter and the input stages of the receiver.
Nominal part of the Predicate	Wide bandwidth signals are a challenge for any type of digital signal processing hardware.
Object	High frequencies alone do not put a limitation on DSP processor capability.
Adjunct	Bandpass signals can be sampled at a rate no less than the bandwidth of the signal.

Task 97. Skim the following text and try to understand the subject- matter of the text:

TEXT 3.4:

MILITARY RADIO SIGNAL PROCESSING REQUIREMENTS

1. Military communication systems often require the use of spread spectrum techniques to provide an anti-jam (AJ) capability; or some measure of covertness through the use of low probability of intercept (LPI) waveforms. The result is that extremely wide bandwidth signals are present at the output stage of the transmitter and the input stages of the receiver.

2. We know from the Nyquist theorem and fundamental bandpass sampling techniques that bandpass signals can be sampled at a rate no less than the bandwidth of the signal; so high frequencies alone do not put a limitation on DSP processor capability. However, wide bandwidth signals are a challenge for any type of digital signal processing hardware, and they are especially troublesome for conventional DSP microprocessors. While conventional DSP microprocessors are optimized for real-time data processing, they are nevertheless implemented using the traditional von Neumann architecture – an inherently serial architecture which uses a single multiplier and executes one instruction at a time.

3. While providing the advantage of flexibility through programmability, this architecture limits the speed with which signal samples can be processed. Even modern DSP microprocessors operating at 40 million instructions per second (MIPS) have a useful bandwidth limit of less than 500 kHz. This is especially troublesome for military communication systems which employ Al and LPI waveforms having typical bandwidths in excess of 10 MHz.

Task 98. Comprehension check:

1. Why do military communications systems require the use of spread spectrum techniques?

2. What do we know from the Nyquist theorem and fundamental bandpass sampling techniques?

3. How are conventional DSP microprocessors implemented?

4. What drawback does the traditional von Neumann architecture have?

5. Modern DSP microprocessors have a useful bandwidth limit of less than 500 kHz, don't they?.

Task 99. Memorize the given words and combinations and translate the following sentences:

1. covertness – *скрытность действий, бесшумность*
intercept – *перехватывать, прерывать, перехват*

Military communication systems often require the use of spread spectrum techniques to provide an anti-jam capability; or same measure of covertness through the use of low probability of intercept waveforms.

2. processing – *обработка*
single – *единственный, одиночный*

While conventional DSP microprocessors are optimized for real-time data processing, they are nevertheless implemented using the traditional von Neumann architecture – an inherently serial architecture which uses a single multiplier and executes one instruction at a time.

3. advantage – *преимущество*
to limit – *ограничивать*
signal sample – *импульсный сигнал*

While providing the advantage of flexibility through programmability, this architecture limits the speed with which signal samples can be processed.

4. to employ – *использовать, применять*
bandwidth — *диапазон частот, полоса частот*

This is especially troublesome for military communication systems which employ AJ and LPI waveforms having typical bandwidths in excess of 10 MHz.

Task 100. Fill in the gaps with the correct variants:

1. Military communication systems often require the use of spread spectrum techniques . . . . . an anti-jam capability.

a) to eliminate b) to recover c) to increase d) to provide

2. Bandpass signals can be . . . . . at a rate no less than the bandwidth of the signal.

a) adjusted b) sent c) sample d) intercepted

3. Wide bandwidth signals are . . . . . for conventional DSP microprocessors.

a) suitable b) typical c) imperceptible d) troublesome

4. The traditional von Neumann architecture uses a . . . . . multiplier.

a) single b) compound c) simple d) double

5. This architecture . . . . . .the speed with which signal samples can be processed.

a) exceeds b) limits c) accelerates d) retards

Task 101. Sum up the text using the following plan:

1. The requirements for military communication systems.

2. The Nyquist theorem and wide bandwidth signal.

3. The traditional von Neumann architecture and its drawback.

4. Modern DSP microprocessors.

ACTIVITY 5: VOCABULARY WORK AND DISCUSSION

Task 102. Study the following words and word combinations:

1) hardware – *аппаратное обеспечение*
2) to implement – *внедрять, использовать*
3) framework – *остов, каркас, корпус*
4) flexibility – *гибкость*
5) requirement – *требование*
6) processing – *обработка*

7) architecture – *модель, структура*
8) down conversion – *понижающее преобразование*
9) spread spectrum technique – *метод передачи сигналов с расширенным спектром*

Task 103. Translate the following sentences into Russian:

1. The digital-signal processing hardware performs a variety of operations on the signal including down conversion.
2. The hardware implements digital-signal processing algorithms for all stages of the radio system.
3. Radio system is still limited in speed, accuracy and flexibility.
4. Military communication systems often require the use of spread spectrum techniques to provide some measure of covertness.
5. Low probability of intercept (LPI) waveforms is employed in the military communication systems.
6. The mathematics of digital signal processing provides the framework for the design of software radio algorithms.
7. A signal architecture uses a single multiplier.

Task 104. Define the meanings of the following words using English-English dictionary. The first example is given for you.

1. *challenge – a problem, difficult to cope with*
2. accuracy (n)
3. framework (n)
4. flexibility (n)
5. to implement (v)
6. coherent (adj)
7. band (n)

Task 105. For the words given in A column find the Russian equivalent in B column.

A	B
hardware	скрытность, бесшумность
to implement	программный каркас
flexibility	единственный, одиночный
software	перехватывать, прерывать
processing	внедрять, использовать

framework	аппаратное обеспечение
covertness	гибкость, оперативность
single	обработка
to intercept	программное обеспечение

Task 106. Here are some words that you may find difficult to translate as they have several meanings. Decide which meaning is the correct one in the following sentences:

1. 1) operates
   2) cores
   3) implements

A new approach that employs digital electronics …. most of the analog signal processing functions in radio.

2. 1) framework
   2) flexibility
   3) spectrum

The mathematics of digital signal processing provides ..... for the design of software radio algorithms.

3. 1) hardware
   2) software
   3) device

It is no longer uncommon to sample a received signal at the intermediate frequency stage and process the signal with numerical algorithms using a specialized digital signal processing .....

4. 1) frequency
   2) coherency
   3) accuracy

The hardware currently available to implement DSP algorithms for all stages of the radio systems is still limited in speed, …….. and flexibility.

5. 1) inputting
2) processing
3) outputting

While conventional digital-signal processing (DSP) microprocessors are optimized for real-time data …….. they are nevertheless implemented using the traditional von Neumann architecture.

Task 107. Try to find the meaning of the given acronyms using a glossary:

Example: DSP – Digital-Signal processing

ADC, DAC, AJC, IF, MAC, ASIC, ASSP, FIR, FPJA, ASSP.

Task 108. Choose the best variant to complete the following sentences using acronyms:

Pattern:

The hardware currently available to implement (DSP, FIR, ASSP) algorithms.

See keys at the end of the Activity V.

1. There exist (ADC, DSP) and (DAC, FIR) converters.

2. The (DSP, ADC, FIR) hardware performs a variety of operations.

3. The analog signal processing operations of the radio transmitter and receiver are implemented with digital hardware using (DSP, FIR, ASIC) techniques.

4. Microprocessors include (ASSP, FIR, FPJA) products.

5. A conventional microprocessor has a (MAC, DSP, ASIC) stage.

DISCUSSION

In groups of four discuss the following problems. Share your answers with the whole group.

1. Discuss the changes that are now taking place in radio systems.

2. Comment upon military radio systems which pose a notable challenge.

3. Discuss the main functions and characteristics of the software radio.

4. Figure out advantages of specialized digital hardware.

Keys: 1. ADC, DAC; 2. DSP; 3. DSP; 4. ASSP; 5. MAC

OUTCLASS ACTIVITY

Task 109. Read the text and give the written translation using your dictionary. Pay attention to the infinitival constructions and their forms.

TEXT 1:

MULTI-JUNCTION SEMICONDUCTOR DEVICES

1. Originally, devices that needed to amplify a signal (such as radios and the first computers), used the vacuum-tube amplifier. This was the original “triode”: a glass tube containing a heater filament, a heated emitter plate (the cathode) that emits electrons, a collector plate (the anode) that collects the electrons once they have accelerated through the tube, and a metal grid in between. The name “triode” came from the fact that the device had three active elements – the anode, the cathode, and the grid. Small changes to the voltage of the grid cause large changes in the electron current flowing to the collector plate. Remove the grid, and the device becomes a vacuum-tube diode.

2. Vacuum-tube triodes work for many purposes, but were slow, bulky, fragile, and consumed copious amounts of power. For years, researchers around the globe tried to make a solid-state version of the device in an attempt to enable the creation of smaller, faster, less power-hungry electronics. The field-effect transistor was patented by the German scientist Julius Lilienfeld in 1926, although he likely never got it to work. Meanwhile, the German physicist Robert Pohl made a solid-state amplifier in 1938 using salt as the semiconductor – it worked, but reacted to signals too slowly to be of any use. Finally, three scientists (John Bardeen, Walter Brattain, and William Shockley) working at Bell

Laboratories discovered how to make the first workable solid-state transistor on December 23, 1947.

3. Their first working device was a “point-contact transistor” – Shockley’s team had modified a “cat’s whisker”-style diode by placing two fine metal wires close together on the surface of a piece of N-type germanium. The result could also be called a “triode”, because it has three terminals – the two free ends of the diodes and their common junction. A voltage applied to the junction controls a current flowing through the other two terminals.

4. Point-contact transistors, though, were essentially laboratory curiosities – they were hard to make (performance depended on the exact placement of the wires on the germanium), and none too reliable (since they responded nearly as much to their surroundings as to their input signals). Research continued.

5. A month after the birth of the point-contact transistor, Shockley realized that Russell Ohl’s P-type and N-type semiconductors in effect made it possible to build a solid-state analog of the vacuum tube triode. The solution was to sandwich a thin P-type semiconductor between two N-type pieces, resulting in two P-N junctions (i.e., two diodes) face to face. A current applied to the P-type layer could then control the current between the two N-type regions. The resulting bipolar transistor proved much more reliable than the point-contact transistor. In the bipolar transistor (as in all modern transistors), the vital junctions between the N-type and P-type layers are buried deep within the semiconductor crystal where they cannot be affected by their surroundings.

6. There are two general types of transistors in use today: (1) the bipolar transistor (often called the bipolar junction transistor, or BJT), and (2) the field-effect transistor (FET). The bipolar transistor, composed of two closely coupled P-N junctions, is bipolar in that both electrons and holes are involved in the conduction process. It is readily able to deliver a change in output voltage in response to a change in input current. This type of transistor is widely used as an amplifier and is also a key component in oscillators, high-speed integrated circuits, and switching circuits.

7. In contrast to the bipolar transistor, the FET is a unipolar device, its conducting process primarily involves only one kind of charge carrier. It can be built either as a metal-oxide-semiconductor field-effect transistor (MOSFJET) or as a junction field-effect transistor (JFET).

Task 110. Sum up the text according to the plan:

1. The origin of the word “triode”.

2. The inventors of a transistor.

3. The bipolar transistor

4. The unipolar (field-effect) transistor

IV. WIRELESS

ACTIVITY 1

Text 4.1: WIRELESS
Grammar: COMPOSITION OF ADJECTIVES

Task 111. Look through the table and learn the main ways of word formation:

SUFFIXES AND PREFIXES FOR FORMATION	MEANING	EXAMPLE
(сущ. +) -al (сущ. +) -ic (сущ. +) -ical (сущ. +) -ous (сущ. +) -ful (гл. +) -able, -ible (гл. +) -ant, -ent (гл. +) -ive (сущ. +) -ly (сущ. +) -y (гл. +) -ite -ary -ate -ed	наличие признака, свойств и качеств, выраженных основой	electric**al –** электрический electron**ic** – электронный vis**ible –** видимый

-less	отсутствие качества, признака	wire**less**- беспроводной
-like	сходство	atom**like**- атомоподобный
un- in- im- ir - il – non-	отрицательное значение	**Im**possible- невозможный
re- (+ гл.)	вновь может сделать то, на что указывает основа	**re**newable- возобновляемый

Task 112. Derive opposites to the following adjectives, then, translate them:

1. Cord - ……
2. Visible - ……
3. Practical - …….
4. Regular - ……..
5. Legal - ……..
6. Reliable - …….
7. Effective - …….
8. Resolute -…….
9. Pair - …….

Task 113. Skim the following text and try to understand the subject-matter of the text:

TEXT 4.1:

WIRELESS

1. The term "*wireless*" is normally used to refer to any type of electrical or electronic operation which is accomplished without the use of a "hard wired" connection. *Wireless communication* is the transfer of information over a distance without the use of electrical conductors or wires. The distances involved may be short (a few meters as in television remote control) or very long (thousands or even millions of kilometers for radio communications). When the context is clear, the term is often simply shortened to "wireless". Wireless communication is generally considered to be a branch of telecommunications.

2. It encompasses cellular telephones, personal digital assistants (PDAs), and wireless networking. Other examples of wireless technology include GPS units, garage door openers, wireless computer mice and keyboards, satellite television and cordless telephones.

3. Wireless operations permit services, such as long range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunication systems (e.g., radio transmitters and receivers, remote controls, computer networks, network terminals, etc.) which use some form of energy (e.g. radio frequency (RF), infrared light, laser light, visible light, acoustic energy, etc.) to transfer information without the use of wires. Information is transferred in this manner over both short and long distances.

4. Wireless communication may be via:

– *radio frequency communication,*

– *microwave communication*, for example long-range line-of-sight via highly directional antennas, or short-range communication,

– *infrared (IR) short-range communication*, for example from remote controls,

5. Applications may involve point-to-point communication, point-to-multipoint communication, broadcasting, cellular networks and other wireless networks.

6. The term "wireless" should not be confused with the term

"cordless", which is generally used to refer to powered electrical or electronic devices that are able to operate from a portable power source (e.g., a battery pack) without any cable or cord to limit the mobility of the cordless device through a connection to the main power supply. Some cordless devices, such as cordless telephones, are also wireless in the sense that information is transferred from the cordless telephone to the telephone's base unit via some type of wireless communications link. This has caused some disparity in the usage of the term "cordless".

7. In the last 50 years, wireless communication industry experienced drastic changes driven by many technology innovations.

Task 114. Answer the following questions:

1. What kind of devices are defined by the term "wireless"?

2. What services do wireless operations permit?

3. What devices of wireless technology do you know?

4. How may wireless communication be implemented?

5. Why should the term "wireless" not be confused with the term "cordless"?

6. What is the reason for drastic changes of wireless communications in the last 50 years?

Task 115. Fill in the gaps with the correct variants:

1. The term wireless is normally used to refer to any type of electrical or electronic operation which is …….. without the use of a "hard wired" connection.

a) supported b) accomplished c) produced d) experienced

2. The distances …… may be short (a few meters as in television remote control) or very long (thousands or even millions of kilometers for radio communications).

a) included b) implied c) appropriate d) involved

3. Wireless operations ……. services, that are impossible or impractical to implement with the use of wires.

a) fulfill b) hinder c) supply d) permit

4. The term "wireless" should not be confused with the term "cordless", which is used to refer to powered electrical or electronic devices that are able to operate from a …….. power source.

a) feasible b) huge c) portable d) complicated

5. In the last 50 years, wireless communication industry experienced changes …… by many technology innovations.

a) promoted b) owing c) suggested d) driven

Task 116. Match the words with their definitions:

innovation	not sensitive or realistic; irrealizable
remote	transmitting TV or radio programmes
mobility	a set of keys on a computer terminal
cordless	very significant and noticeable
digital	mobile access
drastic	a new solution; developments
impractical	a new idea or method broadcasting far away in distance or time
keyboard	giving information by displaying numbers
broadcasting	having no wires attached to equipment

Task 117. Sum up the text “Wireless’’.

ACTIVITY 2

Text 4.2: Wi-Fi
Grammar: VERB "TO BE" AND ITS FUNCTIONS IN ENGLISH SENTENCE

Task 118. Look through the table and learn the main functions of the verb "to Be":

THE FUNCTION OF THE VERB "TO BE"	EXAMPLE
Predicate	Wi-Fi router is on the shelf in our university laboratory.
Link-verb	Wi-Fi Direct is a Wi-Fi standard enabling devices to easily connect with each other.
Auxiliary verb	Wi-Fi Direct devices are set up to require the proximity of a near field communication. Conventional Wi-Fi networks are typically based on the presence of controller devices.
Modal verb	Wi-Fi Direct is to connect devices even if they are from different manufacturers.

Task 119. Fill in the gaps the proper form of the verb "to be", explain its function in each sentence and translate:

1. One advantage of Wi-Fi Direct ___the ability to connect devices.
2. Wi-Fi Direct ____ to establish a peer-to-peer connection.
3. The majority of Wi-Fi networks_____installed in "infrastructure mode".
4. Wi-Fi systems and networks ___in wide use nowadays.
5. Wireless mice, keyboards, remote controls, headsets, speakers, displays ___implemented with Wi-Fi Direct.

Task 120. Read the following text carefully and try to understand its contents:

TEXT 4.2:

WI-FI DIRECT

1. Wi-Fi Direct, initially called Wi-Fi P2P, is a Wi-Fi standard enabling devices to easily connect with each other without requiring a wireless access point. It is usable for everything from internet browsing to file transfer, and to communicate with more than one device simultaneously at typical Wi-Fi speeds. One advantage of Wi-Fi Direct is the ability to connect devices even if they are from different manufacturers. Only one of the Wi-Fi devices needs to be compliant with Wi-Fi Direct to establish a peer-to-peer connection that transfers data directly between them with greatly reduced setup.

2. Wi-Fi Direct negotiates the link with a Wi-Fi Protected Setup system that assigns each device a limited wireless access point. The "pairing" of Wi-Fi Direct devices can be set up to require the proximity of a near field communication, a Blue-tooth signal, or a button press on one or all the devices. Wi-Fi Direct may not only replace the need for routers, but may also replace the need of Blue-tooth for applications that do not rely on low energy.

3. Conventional Wi-Fi networks are typically based on the presence of controller devices known as wireless access points. These devices normally combine three primary functions:

1. Physical support for wireless and wired networking.

2. Bridging and routing between devices on the network.

3. Service provisioning to add and remove devices from the network.

4. A typical Wi-Fi home network includes laptops, tablets and phones, devices like modern printers, music devices and televisions. The majority of Wi-Fi networks are set up in "infrastructure mode", where the access point acts as a central hub to which Wi-Fi capable devices are connected. The devices do not communicate directly with each other (that is, in "ad-hoc mode"), but they go through the access point. Wi-Fi Direct devices are able to communicate with each other without requiring a dedicated wireless access point. The Wi-Fi Direct devices negotiate when they first connect to determine which device shall act as an access point.

5. As the number and type of devices attaching to Wi-Fi systems increased, the basic model of a simple router with smart computers became increasingly strained. At the same time, the increasing sophistication of the hot spots presented setup problems for the users. To address these problems, there have been numerous attempts to simplify certain aspects of the setup task.

6. It became common for smart phones and portable media players to include Wi-Fi as a standard feature, and over time it has become common in feature phones as well. The process of adding Wi-Fi to smaller devices has accelerated, and it is now possible to find printers, cameras, scanners and many other common devices with Wi-Fi in addition to other connections, like USB.

7. Wi-Fi Direct can provide a wireless connection to peripherals. Wireless mice, keyboards, remote controls, headsets, speakers, displays and many other functions can be implemented with Wi-Fi Direct.

Task 121. Match the words with their definitions:

to require	privilege; benefit
ad hoc	to be installed
advantage	to be compatible with
to be compliant with	to need, to feel the need of smth, to want
device	normal option; basic equipment
hub	special; used only for this purpose
to be set up	point-to-point
dedicated	dock; docking station
standard feature	component, element; apparatus

Task 122. Fill in the gaps with the correct variants:

1. Wi-Fi Direct is a Wi-Fi standard enabling devices to easily

connect with each other without requiring a wireless ……..... .

a) standard feature b) router c) access point

2. The basic advantage of Wi-Fi Direct is the ability to …….. even if they are from different manufacturers.

a) negotiate equipment b) connect devices c) set up programmes

3. …….Wi-Fi networks are typically based on the presence of controller devices known as wireless access points.

a) conventional b) standard c) practical

4. A typical Wi-Fi …….. network includes laptops, tablets and phones, devices like modern printers, music devices and televisions.

a) domestic b) local c) home

5. It became ……. for smart phones and portable media players to include Wi-Fi as a standard feature.

a) useful b) common c) necessary

Task 123. Sum up the text using the following plan:

1. The nature of Wi-Fi communication.
2. Wi-Fi Direct devices and their functions.
3. Conventional Wi-Fi networks.
4. The types of equipment and the ways of Wi-Fi connection.
5. The essence of typical Wi-Fi home network

ACTIVITY 3

Text 4.3: GENERAL PACKET RADIO SERVICE (GPRS)
Grammar: PAST SIMPLE ACTIVE AND PASSIVE

Task 124. Look through the table and learn the means of expressing past actions with the use of Past Simple Tense:

MEANS OF EXPRESSING PAST ACTIONS	FORMATION	EXAMPLES
PAST SIMPLE (ACTIVE VOICE)	*Was; were +* *Verb + -ed if regular* *Verb from the second column of irregular verbs*	The early typical portable radio **was** about the size and weight of a lunchbox, and **contained** several heavy (and non-rechargeable) batteries.
PAST SIMPLE (PASSIVE VOICE)	*Was/ were + Participle II (verb +ed/ the third column of irregular verbs*	The "transistor" **was powered** by standard flashlight batteries or a single compact 9-volt battery.

Task 125. Look through the text in the task 126 and find all the sentences where verbs are used in Present Simple Active or Passive. Choose any five sentences and rewrite them using Past Simple Active Voice or Past Simple Passive Voice. Don't forget to add "two years ago, last year, in 1995" etc.

Task 126. Read the following text carefully and try to understand its contents:

TEXT 4.3:

GENERAL PACKET RADIO SERVICE (GPRS)

1. General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM). GPRS was originally standardized by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i-mode packet-switched cellular technologies. It is now maintained by the 3rd Generation Partnership Project.

2. GPRS usage is typically charged based on volume of data transferred, contrasting with circuit switched data, which is usually billed per minute of connection time. Usage above the bundle cap is either charged per megabyte or disallowed.

3. GPRS is a best-effort service, implying variable throughput and latency that depend on the number of other users sharing the service concurrently, as opposed to circuit switching, where a certain quality of service is guaranteed during the connection. In 2G systems, GPRS provides data rates of 56–114 kbit/second. 2G cellular technology combined with GPRS is sometimes described as 2.5G, that is, a technology between the second (2G) and third (3G) generations of mobile telephony. It provides moderate-speed data transfer, by using unused time division multiple access (TDMA) channels in, for example, the GSM system. GPRS is integrated into GSM Release 97 and newer releases.

4. The GPRS core network allows 2G, 3G and WCDMA mobile networks to transmit IP packets to external networks such as the Internet. The GPRS system is an integrated part of the GSM network switching subsystem.

5. GPRS extends the GSM Packet circuit switched data capabilities and makes the following services possible:

1. SMS messaging and broadcasting
2. "Always on" internet access
3. Multimedia messaging service (MMS)

4. Push to talk over cellular (PoC)

5. Instant messaging and presence – wireless village

6. Internet applications for smart devices through wireless application protocol (WAP)

7. Point-to-point (P2P) service: inter-networking with the Internet (IP)

8. Point-to-Multipoint (P2M) service: point-to-multipoint multicast and point-to-multipoint group calls

6. If SMS over GPRS is used, an SMS transmission speed of about 30 SMS messages per minute may be achieved. This is much faster than using the ordinary SMS over GSM, whose SMS transmission speed is about 6 to 10 SMS messages per minute.

7. Devices supporting GPRS are divided into three classes:

Class A

Can be connected to GPRS service and GSM service (voice, SMS), using both at the same time. Such devices are known to be available today.

Class B

Can be connected to GPRS service and GSM service (voice, SMS), but using only one or the other at a given time. During GSM service (voice call or SMS), GPRS service is suspended, and then resumed automatically after the GSM service (voice call or SMS) has concluded. Most GPRS mobile devices are Class B.

Class C

Can be connected to either GPRS service or GSM service (voice, SMS). Must be switched manually between one or the other service.

8. A true Class A device may be required to transmit on two different frequencies at the same time, and thus will need two radios. To get around this expensive requirement, a GPRS mobile may implement the dual transfer mode (DTM) feature. A DTM-capable mobile may use

simultaneous voice and packet data, with the network coordinating to ensure that it is not required to transmit on two different frequencies at the same time. Such mobiles are considered pseudo-Class A, sometimes referred to as "simple class A". Some networks support DTM since 2007.

Task 127. Answer the following questions:

1. What is known as General packet radio service (GPRS)?
2. GPRS was originally standardized by European Telecommunications Standards Institute, wasn't it?
3. Is the GPRS system an integrated part of the GSM network switching subsystem?
4. What services are possible due to GPRS?
5. May an SMS transmission speed of about 30 SMS messages per minute be achieved, if SMS over GPRS is used?
6. What classes of devices supporting GPRS are there?
7. Why does a GPRS mobile implement the dual transfer mode (DTM) feature?

Task 128. Read the following sentences and try to translate them into English or if you have some difficulty, you may simply convey the meaning:

1. GPRS – надстройка над технологией мобильной связи GSM, осуществляющая пакетную передачу данных.
2. GPRS позволяет пользователю сети сотовой связи производить обмен данными с другими устройствами в сети GSM и с внешними сетями, в том числе Интернет.
3. GPRS предполагает тарификацию по объёму переданной/полученной информации, а не по времени, проведённому онлайн.
4. Служба передачи данных GPRS надстраивается над существующей сетью GSM.

5. На структурном уровне систему GPRS можно разделить на две части: подсистему базовых станций (BSS) и опорную сеть GPRS (GPRS Core Network).
6. В BSS входят все базовые станции и контроллеры, которые поддерживают пакетную передачу данных.
7. При использовании GPRS информация собирается в пакеты и передаётся через неиспользуемые в данный момент голосовые каналы.

Task 129. Match the terms with their explanation/ definitions:

General packet radio service (GPRS)	is the most popular standard for mobile phones in the world.
GSM	is the transfer of information over a distance without the use of electrical conductors or wires.
Wi-Fi Direct	is normally used to refer to any type of electrical or electronic operation which is accomplished without the use of a "hard wired" connection.
"Wireless"	is a packet oriented mobile data service.
Wireless communication	is a standard enabling devices to easily connect with each other without requiring a wireless access point.

Task 130. Sum up the text using the following plan:

1. General packet radio service (GPRS)
2. GPRS usage
3. GPRS core network
4. GSM Packet circuit switched data capabilities and services
5. Three classes of devices supporting GPRS

ACTIVITY 4

Text 4.4: GSM – GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS
Grammar: PERFECT TENSES (ACTIVE AND PASSIVE)

Task 131. Look through the table and learn how and where you can use Perfect Tenses.

MEANS OF EXPRESSING PERFECT ACTIONS (**they happened before some moment**)	**FORMATION**	**EXAMPLES**
PRESENT PERFECT (ACTIVE VOICE) **(PASSIVE VOICE)**	Have/ has + (Verb+ed/ Participle II) Have/ has been+ (Verb+ed/ Participle II)	The key advantage of GSM systems **has been** better voice quality and low-cost alternatives.
PAST PERFECT (ACTIVE VOICE) **(PASSIVE VOICE)**	Had + (Verb+ed/ Participle II) Had been + (Verb+ed/ Participle II)	GSM **had** already **been used** by over 2 billion people across more than 212 countries and territories by 2010.
FUTURE PERFECT (ACTIVE VOICE) **(PASSIVE VOICE)**	Will have + (Verb+ed/ Participle II) Will have been+ (Verb+ed/ Participle II)	GSM **will have been designed** with a moderate level of security by the end of the next year.

Task 132. Find and underline Perfect Tenses Active and Passive Voices in the English sentence. Translate the following sentences.

1. GSM has already become the most popular standard for mobile phones in the world.	1. *Система GSM уже стала самым популярным стандартом для мобильных телефонов в мире*. Present Perfect Active
2. By the end of the last month designers had announced that the SIM card was a detachable card.	
3. One of the key features of GSM will have been the Subscriber Identity Module (SIM), commonly known as a SIM card.	
4. The system has just been designed to authenticate the subscriber using an authentication key and response.	
5. GSM will have used several algorithms for security by next year.	
6. The key stored on SIM card has never been sent over the air interface.	
7. Picocells are small cells whose coverage diameter is a few dozen meters; they have been mainly used indoors.	

Task 133. Read the following text carefully and try to understand its contents:

TEXT 4.4:

GSM – GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS

1. GSM is the most popular standard for mobile phones in the world.

Its promoter, the GSM association, estimates that 82% of the global mobile market uses the standard. GSM is used by over 2 billion people across more than 212 countries and territories. GSM enables roaming between mobile phone operators to use their phones in many parts of the world. GSM differs from its predecessors in that both signaling and speech channels are digital call quality and so it is considered a second generation mobile system. The GSM logo is used to identify compatible handsets and equipment. The key advantage of GSM systems has been better voice quality and low-cost alternatives to making calls, such as Short message service (SMS).

Technical details:

2. GSM is a cellular network which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in 900 MHz or 1800 MHz bands. There are four different cell sizes in GSM network – macro, micro, pico and umbrella cells. The coverage area of each varies according to the implementation environment. It depends on the coverage diameter. For instance, picocells are small cells whose coverage diameter is a few dozen meters, they are mainly used indoors. One of the key features of GSM is the Subscriber Identity Module (SIM), commonly known as a SIM card. The SIM card is a detachable card containing the user's subscription information and phonebook.

GSM security

3. GSM was designed with a moderate level of security. The system was designed to authenticate the subscriber using an authentication key and response – authentication the user to the network and vice versa. Communications between the subscriber and the base station can be encrypted. The security model therefore offers confidentiality and authentication. GSM uses several algorithms for security, such as A5/1 and A5/2 for ensuring over-the-air voice privacy. So the key stored on SIM card never sends over the air interface. This is a large security advantage of GSM.

Task 134. Answer the following questions:

1. What standard is known as GSM?
2. Is GSM popular in many countries and territories?

3. What does GSM have a logo for?

4. Is GSM a cellular network?

5. What are GSM frequency ranges?

6. Why do the cells have different sizes?

7. What's the coverage area?

8. What's a SIM card?

9. Can we say that GSM has a moderate level of security and why?

Task 135. Fill in the gaps with the correct variants:

1. GSM was ….. to make roaming between mobile phone operators.

a) delivered b) serviced c) designed d) carried

2. GSM is a cellular network, which means that mobile phones ….to it by searching for cells in the immediate vicinity.

a) execute b) implement c) transmit d) connect

3. The coverage area of cells …… coverage diameter.

a) connects b) influences c) achieves d) depends on

4. Communications between the subscriber and the base station can be ….

a) encrypted b) moved c) transmitted d) operated

5. The security offers ……

a) representation b) subscription c) confidentiality d) promotion

Task 136. Match the synonymic words as in the example:

a logo	to look for
to operate	to fulfil; to adapt; to introduce; to put into practice
an authentication	to guarantee; to ascertain smth
to estimate	a neighbourhood; circumference
to search for	1) subscription details; login data; 2) emblem
to implement	to function
to ensure	to value; to guess; to calculate
vicinity	a tampler-proofing; verification

Task 137. Sum up the text according to the following plan:

1. The key advantages of GSM.
2. The technical details of GSM.
3. GSM security.

ACTIVITY 5: VOCABULARY WORK AND DISCUSSION

Task 138. Translate the following words and word combinations:

To refer to, involved, digital, to encompass, network, frequency, broadcasting, discrete value, spark signals, capacitor, flashlight battery, portable, picocell

Task 139. Translate the following sentences into Russian without using a dictionary:

1. This portable digital device is powered by standard flashlight batteries.

2. Spark signals were distinct at low frequencies.

3. Broadcasting company was involved in the design of this well-known network.

4. The term “digital” is used to refer to any type of electronic equipment and device using discrete values.

Task 140. Define the meanings of the given words using English-English dictionary. The first example is given to you.

1) a message – *a communication containing news, advice, request, information, sent by messenger, telephone, e-mail or other means*

2) e-mail worm 3) an information overload

4) an access 5) a backup

6) spamming 7) roaming

Task 141. Match the synonymic words as in the example:

confidentiality	numerical
a message	service software/ program
digital	to clear; to cancel
a route	an element
a precaution	security; privacy; secretiveness
to indicate	a letter or information sent
a circuit	1) data input/ output; 2) an admission
to delete	a warning
an access	to mark; to signal; to signalize
a component	an electrical diagram/ schematic
an utility	to broadcast; to transfer
to send	trace; tracking

Task 142. Here are some words you may find difficult to translate or use in speech as they have several meanings. Decide which meaning is the correct one in the following sentences.

1. Simple crystal radios are often made with a few…….. parts.

a) manual b) heavy c) hand-made d) composite

2. Crystal radios can be designed to ……. almost any radio frequency since there is no fundamental limit on the frequencies they will receive.

a) propagate b) include c) implement d) receive

3. Radio waves make radio wave electricity flow between the antenna wire and the …… wire.

a) land b) surface c) ground d) bottom

4. The tuner can be as simple as a/an ……. one-slider tuning coil that resonates with the antenna because the antenna also acts like a capacitor.

a) compatible b) adjustable c) coherent d) removable

5. The detector can be made from a special……. of galena in a holder.

a) lump b) bar c) piece d) rock

DISCUSSION

In groups of four discuss the following problems. Share your answers with the whole group.

1. E-mail as a method of sending and receiving messages.

2. Can we say that GSM has a moderate level of security and why?

3. What are the advantages and disadvantages of GSM? Speak about the advantages of transistors before vacuum tubes.

4. What have you learnt about the types of equipment and the ways of radio communication?

OUTCLASS ACTIVITY

Task 143. Read the following text and translate using your dictionary. Then, try to write a summary of the article (See p. 134). While reading, pay attention to Gerundial Constructions, the Gerund and the Participle.

TEXT 4.5:

ELECTRONIC MAIL

1. Electronic mail, abbreviated e-mail or email, is a method of composing, sending, and receiving messages over electronic communication systems. Most e-mail systems today use the Internet.

2. Despite common opinion, e-mail actually predates the Internet; in fact, existing e-mail systems were an important tool in creating the Internet. E-mail started in 1965 as a way for multiple users of a time-sharing mainframe computer to communicate. E-mail was quickly extended to become network e-mail, allowing users to pass messages between different computers. The early history of network e-mail is also murky; the AUTODIN system may have been the first allowing electronic text messages to be transferred between users on different computers in 1966. The ARPANET computer network made a large contribution to the evolution of e-mail.

3. As the utility and advantages of e-mail on the ARPANET became more widely known, the popularity of e-mail increased, leading to demand from people who were not allowed access to the ARPANET. A number of protocols were developed to deliver e-mail among groups of time-sharing computers over different alternative transmission systems.

4. Since not all computers or networks were directly inter-networked, e-mail addresses had to include the "route" of the message, that is, a path between the computer of the sender and the computer of the receivers. E-mail could be passed this way between a number of networks.

5. Internet e-mail messages consist of two major components:

headers – message summary, sender, receiver, and other information about the e-mail;

body – the message itself

The headers usually have at least four fields:

1. From: The e-mail address of the sender of the message

2. To: The e-mail address of the receiver of the message

3. Subject: A brief summary of the contents of the message

4. Date: The local time and date when the message was originally sent.

6. Messages are exchanged between hosts using the Mail Transfer Protocol. Mails can be stored either on the client or on the server side. When a message cannot be delivered, the recipient must send a message back to the sender, indicating the problem.

7. The usefulness of e-mail is being subjected by two phenomena, spamming and e-mail worms. Spamming is unsolicited commercial e-mail. Because of the very low cost of sending e-mail, spammers can send hundreds of millions of e-mail messages each day over an inexpensive Internet connection. It generates an Information overload for many computer users who receive tens or even hundreds of e-mails each day. E-mail worms use e-mail as a way of replicating themselves into exposed computers. Although the first e-mail worm affected early computers, this problem is today almost entirely confined to the modern operating system.

8. E-mail privacy, without some security precautions, can be compromised because:

– e-mail messages are generally not encrypted;

– e-mail messages have to go through intermediate computers before reaching their destination, meaning it is relatively easy for others to read messages;

– many Internet Service Providers store copies of your email messages on their mail servers before they are delivered. The backups of

these can remain up to several months on their server, even if you delete them in your mailbox.

9. If compare it with other means of communication we can underline that e-mail is very fast, cheap and modern. You can download music and video, send letters and pictures. It's informal. Of course privacy and security may be problems, but who sends important documents by e-mail?

Task 144. Answer the following questions:

1. What is e-mail?
2. Do most e-mail systems use the Internet today?
3. Do we use e-mail to pass messages?
4. What is the ARPANET?
5. What's the difference between headers and body?
6. What are the main fields of the headers?
7. What is a spammer?
8. What are e-mail security precautions?

Task 145. Complete the following sentences:

1. E-mail started ….
2. A number of protocols were developed……
3. Mails can be stored….
4. Hundreds of active spammers……
5. If compare it with other means of communication……

V. CONDUCTORS, SEMICONDUCTORS AND INSULATORS

CLASS ACTIVITY

ACTIVITY 1

Text 5.1: CONDUCTORS, INSULATORS AND ELECTRON FLOW (Part 1)
Grammar: CONJUNCTIONS

Task 146. Look through the table and study English conjunctions and their meaning:

CONJUN-CTIONS	**MEANING**	**EXAMPLE**
if	on the conditions that (если)	If we want electrons to flow in a certain place, we must provide the proper path for them to move.
because	for the reason that (так как, поскольку)	Because these virtually unbound electrons are free to leave their respective atoms and float around in the space between adjacent atoms, they are often called free electrons.
since	for the reason that (так как)	Since the wire is made of a conductive material, such as copper, its constituent atoms have many free electrons, which can easily move through the wire.

though; even though	despite the fact that (даже несмотря на; хотя)	Even though each marble only travelled a short distance, the transfer of motion through the tube is virtually instantaneous from the left end to the right end.
while	1) at the same time as (в то время как; пока)	While external forces such as physical rubbing can force some of these electrons to leave their respective atoms and transfer to the atoms of another material, they do not move between atoms within that material very easily.
	2) by contrast (кроме того; в то время как; а; и в то же время)	Materials with high electron mobility are called conductors, while materials with low electron mobility are called insulators.

Task 147. Find the conjunctions in the following English sentences. Pay attention to their Russian equivalents.

1. Because these virtually unbound electrons are free to leave their respective atoms and float around in the space between adjacent atoms, they are often called free electrons.

Поскольку данные электроны, являясь фактически освобожденными, способны покидать соответствующие атомы и перемещаться в межатомном пространстве, их часто называют свободными электронами.

2. Materials with high electron mobility are called conductors, while materials with low electron mobility are called insulators.

Материалы с высокой подвижностью электронов называют проводниками, а материалы с малой подвижностью электронов - изоляторами.

3. If a single marble is suddenly inserted into this full tube on the left-hand side, another marble will immediately try to exit the tube on the right.

Если отдельно взятый шарик поместить в эту заполненную трубку с левой стороны, другой шарик сразу же покинет трубку с правой стороны.

4. Since the wire is made of a conductive material such as copper, its constituent atoms have many free electrons which can easily move through the wire.

Так как провод изготовлен из материала, проводящего электрический ток (такие как медь), составляющие его атомы обладают множеством свободных электронов, которые способны легко перемещаться по нему.

5. Even though each marble only travelled a distance, the transfer of motion through the tube is virtually instantaneous from the left end to the right end, no matter how long the tube is.

Несмотря на то, что каждый шарик перемещается на незначительное расстояние, передача движения по трубке осуществляется практически моментально, от левого до правого конца независимо от длины трубки.

Task 148. Memorize the following words and word combinations. Translate the given sentences into Russian:

1. loosely bound – *слабосвязанный, непрочный*
influence – *влияние, воздействие*
outermost — *внешний, самый удаленный от центра*

With some types of materials, such of metals, the outermost electrons in the atoms are so loosely bound that they chaotically move in the space between the atoms of that material by nothing more than the influence of room-temperature that energy.

2. to determine – *определять, устанавливать*
to link – *соединять, связывать*
nucleus – *ядро*

Conductivity is determined by the types of atoms in a material (the number of protons in each atom’s nucleus, determining its chemical identity) and how the atoms are linked together with one another.

3. transparent – *прозрачный*

opaque – *непрозрачный, матовый*

Materials that easily conduct light are called “transparent”, while those that don’t are called “opaque”.

4. rubbing – *трение*
to transfer – *переходить, перемещаться*
external force — *внешняя сила*

While external forces such as physical rubbing can force some of these electrons to leave their respective atoms and transfer to the atoms of another material, they do not move between atoms within that material very easily.

5. conductor – *проводник*
insulator – *изолятор*
mobility – *подвижность (электронов)*

Materials with high electron mobility (many free electrons) are called conductors, while materials with low electron mobility (few or no free electrons) are called insulators.

6. plastic – *пластмасса*
fiberglass – *стекловолокно*

Window glass is better than most plastics, and certainly better than “clear” fiberglass.

7. dimension – *измерение, габаритная величина*
to impact – *прижимать, сильно воздействовать, ударяться*

Physical dimension also impacts conductivity.

8. to experience – *испытывать*
condition – *условие*

It should also be understood that some materials experience changes in their electrical properties under different conditions.

9. to heat – *нагревать*
temperature – *температура*

Gases, such as air, normally insulating materials, also became conductive if heated to very high temperatures.

10. perfectly – *идеально*
extremely – *крайне, чрезвычайно*

Many conductive materials become perfectly conductive (this is called superconductivity) at extremely low temperatures.

Task 149. Read the following text carefully and pay attention to the italicized words and word combinations. Try to understand the subject-matter of the text:

TEXT 5.1:

CONDUCTORS, INSULATORS AND ELECTRON FLOW.
Part 1.

1. The electrons of different types of atoms have different degrees of freedom to move around. With some types of materials, such as metals, the outermost electrons in the atoms are so loosely bound that they *chaotically move* in the space between the atoms of that material by nothing more than the influence of room-temperature heat energy. Because these virtually *unbound electrons* are free to leave their respective atoms and float around in the space between adjacent atoms, they are often called free electrons. In other types of materials such as glass, the atoms' electrons have very little freedom *to move around*. While external forces such as physical rubbing can force some of these electrons to leave their respective atoms and transfer to the atoms of another material, they do not move between atoms within that material very easily.

2. This relative mobility of electrons within a material is known as electric conductivity. Conductivity is determined by the types of atoms in a material (the number of protons in each atom's nucleus, determining its *chemical identity*) and how the atoms are linked together with one another. Materials with high electron mobility (many free electrons) are called conductors, while materials with low electron mobility (few or no free electrons) are called insulators.

Here are a few common examples of conductors and insulators:

Conductors:

• silver • copper • gold • aluminum
• iron • steel • brass • bronze • concrete
• mercury • graphite • dirty water

Insulators:

• glass • rubber • asphalt • (dry) wood
• fiberglass • porcelain • ceramic • oil
• quartz • (dry) cotton • (dry) paper

3. The tube is full of marbles, just as a conductor is full of free electrons ready to be moved by an outside influence. If a single marble is suddenly inserted into this full tube on the left-hand side, another marble will immediately try to exit the tube on the right. Even though each marble only traveled a short distance, the transfer of motion through the tube is virtually instantaneous from the left end to the right end, no matter how long the tube is. With electricity, the overall effect from one end of a conductor to the other happens at the speed of light: a swift 186,000 miles per second!!! Each individual electron, though, travels through the conductor at a much *slower pace*. If we want electrons to flow in a certain direction to a certain place, we must provide the proper path for them to move, just as a plumber must install piping to get water to flow where he or she wants it to flow. *To facilitate* this, wires are made of highly conductive metals such as copper or aluminum in a wide variety of sizes.

4. Remember that electrons can flow only when they have the opportunity to move in the space between the atoms of a material. This means that there can be *electric current* only where there exists a continuous path of conductive material providing a conduit for electrons to travel through. In the marble analogy, marbles can flow into the left-hand side of the tube (and, consequently, through the tube) if and only if the tube is open on the right-hand side for marbles to flow out. If the tube is blocked on the right-hand side, the marbles will just “pile up” inside the tube, and marble “flow” will not occur. The same holds true for electric current: the continuous flow of electrons requires there be an *unbroken path* to permit that flow.

5. Since air is an insulating material, and an air gap separates the two pieces of wire, the once-continuous path has now been broken, and electrons cannot flow from Source to Destination. This is like cutting a

water pipe in two and capping off the broken ends of the pipe: water can't flow if there's no exit out of the pipe. In electrical terms, we had a condition of *electrical continuity* when the wire was in one piece, and now that continuity is broken with the wire cut and separated. If we were to take another piece of wire leading to the Destination and simply make physical contact with the wire leading to the Source, we would once again have a continuous path for electrons to flow.

6. It must be understood that not all conductive materials have the same level of conductivity, and not all insulators are equally resistant to electron motion. Electrical conductivity is analogous to the transparency of certain materials to light: materials that easily "conduct" light are called "transparent," while those that don't are called "opaque." However, not all transparent materials are equally conductive to light. Window glass is better than most plastics, and certainly better than "clear" fiberglass. So it is with electrical conductors, some being better than others. For instance, silver is the best conductor in the "conductors" list, offering easier passage for electrons than any other material cited. Dirty water and concrete are also listed as conductors, but these materials are substantially less conductive than any metal.

7. *Physical dimension* also impacts conductivity. For instance, if we take two strips of the same conductive material – one thin and the other thick – the thick strip will prove to be a better conductor than the thin for the same length. If we take another pair of strips – this time both with the same thickness but one shorter than the other – the shorter one will offer easier passage to electrons than the long one. This is analogous to water flow in a pipe: a fat pipe offers easier passage than a skinny pipe, and a short pipe is easier for water to move through than a long pipe, all other dimensions being equal.

8. It should also be understood that some materials *experience changes* in their electrical properties under different conditions. Glass, for instance, is a very good insulator at room temperature, but becomes a conductor when heated to a very high temperature. Gases such as air, normally insulating materials, also become conductive if heated to very high temperatures. Most metals become poorer conductors when heated, and better conductors when cooled. Many conductive materials become perfectly conductive (this is called superconductivity) at extremely low temperatures.

Task 150. Fill in the gaps with the correct variants:

1. With some types of materials, such as metals, the outermost electrons in the atoms are so . . . . . bound that they chaotically move in the space between the atoms of that material by nothing more than influence of room-temperature heat energy.

a) firmly b) heavily c) loosely d) gently

2. It must be understood that not all conductive materials have the same level of conductivity, and not all insulators are equally . . . . . to electron motion.

a) sensitive b) resistant c) impervious d) subject

3. Physical . . . . . also impacts conductivity.

a) shape b) property c) function d) dimension

4. Some materials . . . . . changes in the their electrical properties under different conditions.

a) develop b) reflect c) experience d) resist

5. Most metals become poorer conductors when . . . . . .

a) heated b) bent c) extracted d) melt

Task 151. Match up the given titles to each paragraph of TEXT 5.1.

1. Classification of materials.

2. Electric conductivity of materials.

3. Properties of conductors and insulators.

4. Temperature coefficient for materials of conductors and insulators.

Task 152. Find key sentences in each paragraph and underline them.

Task 153. Match up the words with their definitions:

to float	not damaged or affected by smith
rubbing	physical characteristic
concrete	friction
transparent	a long, narrow piece of material
strip	a long round hollow object, made of metal
property	building material, composed of cement and sand
dimension	allowing light to pass through
to experience	measurement
pipe	to undergo
resistant	to move gently

Task 154. Organizing your thoughts. Answer the following questions:

1. How much freedom do the electrons have in such materials as glass?

2. What is electrical conductivity analogous to?

3. What kind of materials are called “opaque”?

4. What material is the best conductor?

5. When does glass become a conductor?

6. Do most metals become better or poorer conductors when heated?

7. At what temperatures do conductive materials become perfectly conductive?

Task 155. Sum up the text using the following plan:

1. Classification of materials.
2. Electron conductivity of materials.
3. Temperature coefficient of materials.
4. Factors that impact conductivity

ACTIVITY 2

Text 5.2: CONDUCTORS, INSULATORS AND ELECTRON FLOW (Part 2)
Grammar: DETERMINERS

Task 156. Look through the table and study the types of English determiners and the meanings they convey:

Type of Determiners	**MEANING**	**EXAMPLE**
1. General determiners: a, an, all, another, any, both, each, enough, every, few, less, little, many, more, much, other, several, some	used when you mention people or things for the first time or talk about them generally, without any particular reference	1) As <u>each</u> electron moves uniformly through <u>a</u> conductor, it pushes on the one ahead of it, such that all the electrons move together as <u>a</u> group. 2) <u>Each</u> individual electron travels through <u>any</u> conductor at <u>a much</u> slower pace.

2. Specific determiners: the, this, that, these, those, my, your, his, her, our, their	used to talk about people or things which have already been mentioned or known	1) This uniform motion of electrons is what we call electricity. 2) The liquid flow analogy is so fitting that the motion of electrons through these conductors is often referred to as a flow.

Task 157. Read the following text carefully. Try to understand the subject- matter of the text.

TEXT 5.2:

CONDUCTORS, INSULATORS AND ELECTRON FLOW.

Part 2.

1. While the normal motion of “free” electrons in a conductor random, with no particular direction or speed, electrons can be influenced to move in a coordinated fashion through a conductive material. This uniform motion of electrons is what we call electricity, or electric current. To be more precise, it could be called dynamic electricity in contrast to static electricity, which is an unmoving accumulation of electric charge. Just like water flowing through the emptiness of a pipe, electrons are able to move within the empty space within and between the atoms of a conductor. The conductor may appear to be solid to our eyes, but any material composed of atoms is mostly empty space! The liquid-flow analogy is so fitting that the motion of electrons through a conductor is often referred to as a “flow.”

2. A noteworthy observation may be made here. As each electron moves uniformly through a conductor, it pushes on the one ahead of it, such that all the electrons move together as a group. The starting and stopping of electron flow through the length of a conductive path is virtually instantaneous from one end of a conductor to the other, even though the motion of each electron may be very slow. An approximate analogy is that of a tube filled end-to-end with marbles.

3. Now, we have continuity from the Source, to the newly-made connection, down, to the right, and up to the Destination. This is analogous to putting a “tee” fitting in one of the capped-off pipes and

directing water through a new segment of pipe to its destination. Please take note that the broken segment of wire on the right hand side has no electrons flowing through it, because it is no longer part of a complete path from Source to Destination.

4. It is interesting to note that no “wear” occurs within wires due to this electric current, unlike water-carrying pipes which are eventually corroded and worn by prolonged flows. Electrons do encounter some degree of friction as they move, however, and this friction can generate heat in a conductor. This is a topic we’ll explore in much greater detail later.

5. To sum up, in conductive materials, the outer electrons in each atom can easily come or go, and are called free electrons. In insulating materials, the outer electrons are not so free to move. All metals are electrically conductive. Dynamic electricity, or electric current, is the uniform motion of electrons through a conductor. Static electricity is an unmoving, accumulated charge formed by either an excess or deficiency of electrons in an object. For electrons to flow continuously (indefinitely) through a conductor, there must be a complete, unbroken path for them to move both into and out of that conductor.

Task 158. Comprehension check. Answer the following questions:

1. How is static electricity defined?

2. What is known as uniform motion of electrons?

3. What is the speed of the transfer of motion with respect to electricity?

4. What is the main condition of electron flow?

5. What do we call “free electrons”?

6. Are metals electrically conductive?

7. What is dynamic electricity?

8. What is required for the electrons to flow continuously through a conductor?

Task 159. Match up the words with their definitions:

static	able to pass electric current
free (electron)	steady; constant
conductive	1) steady-state 2) tweeks; atmospherics; atmospheric interference
motion	choke; coil
uniform (motion)	dielectric
accumulation	movement
insulating	storage
swift	unbound, mobile, uncoupled

ACTIVITY 3

Text 5.3: CONDUCTORS AND INSULATORS
Grammar: COMPARATIVE STRUCTURES

Task 160. Look through the table and study the ways of expressing the idea of comparison:

Comparative structure	EXAMPLE
as . . . . . **.as**	Concrete is **as** hard **as** stone.
like	Just **like** water flowing through the emptiness of a pipe, electrons are able to move within the empty space within and between the atoms of a conductor.

the same as	Concrete doesn't have **the same** level of conductivity **as** silver.
more than / **less than**	1) Window glass **is more** transparent **than** plastics. 2) Dirty water and concrete are also listed as conductors, but substantially **less** conductive **than** any metal.

Task 161. Skim the following text and explain the meaning of the words “conductor” and “insulator”.

TEXT 5.3:

CONDUCTORS AND INSULATORS

1. The behavior of an object, which has been charged, is dependent upon whether the object is made of a conductive or a non conductive material. Conductors are materials, which permit electrons to flow freely from atom to atom and molecule to molecule. An object made of a conducting material will permit charge to be transferred across the entire surface of the object. If charge is transferred to the object at a given location, that charge is quickly distributed across the entire surface of the object. The distribution of charge is the result of electron movement. Since conductors allow for electrons to be transported from particle to particle, a charged object will always distribute its charge until the overall repulsive forces between excess electrons is minimized. If a charged conductor is touched to another object, the conductor can even transfer its charge to that object. The transfer of charge between objects occurs more readily if the second object is made of a conducting material. Conductors allow for charge transfer through the free movement of electrons.

2. In contrast to conductors, insulators are materials, which impede the free, flow of electrons from atom to atom and molecule to molecule. If charge is transferred to an insulator at a given location, the excess charge will remain at the initial location of charging. The particles of the insulator do not permit the free flow of electrons; subsequently charge is seldom distributed evenly across the surface of an insulator.

3. While insulators are not useful for transferring charge, they do serve a critical role in electrostatic experiments and demonstrations. Conductive objects are often mounted upon insulating objects. This arrangement of a conductor on top of an insulator prevents charge from being transferred from the conductive object to its surroundings.

4. This arrangement also allows for a student (or teacher) to manipulate a conducting object without touching it. The insulator serves as a handle for moving the conductor around on top of a lab table. This principle was demonstrated in the Pop Can Induction lab and many other demonstrations performed in class. In the Pop Can Induction lab, the pop cans were mounted on top of styrofoam cups. The cups served as insulators, preventing the pop cans from discharging their charge. The cups also served as handles when it was necessary to move the cans around on the table.

5. Examples of conductors include metals, aqueous solutions of salts (i.e., ionic compounds dissolved in water), graphite, water.

Task 162. Answer the following questions:

1. What does the behavior of a charged object depend upon?
2. What is the ultimate result of charge distribution, occurring in conductors?
3. When can a conductor transfer its charge to the neighbouring object?
4. Why is a conductor often mounted on top of an insulator?
5. How does this arrangement of a conductor on top of an insulator help in student's or teacher's work?

Task 163. Match up the words with their meanings:

behavior	water; hydrous
to transfer	to make the progress difficult
distribution	happening at a later time than something else
to impede	the way in which something functions

subsequently	the part of a tool, which you hold in order to pick up and use the object
to mount	to fix something on a particular surface
handle	happening at the beginning of a process
initial	sharing out of something is composed
arrangement	the way in which something is composed
aqueous	to send; to move something to a different position

Task 164. Say whether the following statements are true (T) or false (F):

1. Conductors are materials, which prohibit electrons from flowing freely from atom to atom.

2. The distribution of charge is the result of electron movement.

3. Insulators serve a critical role in electrostatic experiment.

4. The insulator serves as a brake for the conductor from moving around on top of a lab table.

5. Examples of conductors include metals and aqueous solutions of salts.

ACTIVITY 4

Text 5.4: SCIENTIFIC PRINCIPLES: CONDUCTORS, INSULATORS AND SEMICONDUCTORS
Grammar: TYPES OF ADVERBIALS

Task 165. Study the English adverbials and the meaning they convey:

ADVERBIAL	MEANING	EXAMPLE
^ Adjective + ly	manner	Electrons can move freely atoms the orbital within an energy band.
yesterday, today, tomorrow next day, last week, nowadays	time	Nowadays many countries have cable TV, a system using wires for the transmission of television programs.
always, often, never, usually, rarely, frequently, sometimes	frequency	Plastic coatings are frequently found covering copper wires to protect the user from shock and keep devices from short circuiting.
certainly, definitely, probably, possibly, obviously, really, perhaps	probability	Window glass is better than most plastics and certainly better than "clear" fiberglass.

already, still, yet	duration	These designations come from the days of vacuum tubes, but are still in use.
almost, completely, extremely, quite, totally, relatively	degree	A relatively small number of nonmetallic substances can also be classified as conductors.

Task 166. Find the adverbials in the following English sentences, explain their meaning, and translate the sentences.

1. Metals (pure elements and alloys) are typically conductors of electricity.
2. A relatively small number of nonmetallic substances can also be classified as semiconductors.
3. Nowadays plastic coatings are frequently found covering copper wires to protect the user from shock.
4. Ceramic knobs are still used where electrical wires are attached to utility poles or to the back of a house.
5. Pure elements such as silicon probably play an important role in many semiconductor devices.
6. Some other combinations of elements that exhibit semiconductor properties are definitely indicated on this periodic table.

Task 167.Skim the following text. Try to understand the subject-matter of the text:

TEXT 5.4:

SCIENTIFIC PRINCIPLES: CONDUCTORS, INSULATORS AND SEMICONDUCTORS

1. All materials have electrical properties that allow them to be organized into three broad categories: conductors, insulators and semiconductors. Metals (pure elements and alloys) are typically conductors of electricity. Thousands of miles of aluminum and copper wires crisscross the country bringing electricity into our homes and places of work. A relatively small

number of nonmetallic substances can also be classified as conductors. Also, a very few ceramic compounds have exhibited the unusual property of superconductivity at the frigid temperature of liquid nitrogen or below.

2. The nonmetallic elements and their compounds fall into the class of electrical insulators. Most ceramics and plastics do not conduct electricity under ordinary circumstances. Plastic coatings are frequently found covering copper wires to protect the user from shock and keep devices from short- circuiting. Ceramic knobs are used where electrical wires are attached to utility poles or to the back of a house. The third group of materials, the semiconductors, can be understood from their name, to fell somewhere midway between conductors and insulators.

3. Although pure elements such as silicon play an important role in many semiconductor devices, it is most often utilized by adding very small but controlled amounts of impurities in order to alter its properties. Silicon-based materials dominate in the semiconductor industry and in electronic devices like computers and calculators, but a number of other compounds are also used extensively-including GaAs (or gallium arsenide) which is the material used in the laser of a CD player.

4. Some other combinations of elements that exhibit semiconductor properties are indicated on the periodic table. In the readings and lab activities that follow, the emphasis is on what semiconductor materials are, how they are used, what properties they possess, and why they behave as they do.

Task 168. Comprehension check:

1. What categories are all materials divided into?

2. Metals and alloys are conductors of electricity, aren't they?

3. Which property do ceramic compounds exhibit?

4. Do most ceramics and plastics conduct electricity under ordinary circumstances?

5. Where do silicon-based materials dominate?

6. Do the nonmetallic elements and their compounds fall into the class of electrical insulators?

Task 169. Memorize the given words and word combinations and translate the following sentences:

1. property – *свойство, качество*

broad – *широкий*

All materials have electrical properties that allow them to be organized into there broad categories: conductors, insulators and semiconductors.

2. non-metallic – *неметаллический*

to classify – *классифицировать*

A relatively small number of nonmetallic substances can also be classified as conductors.

3. frigid – *холодный*

nitrogen – *азот*

Also, a very few ceramic compounds have exhibited the unusual property of superconductivity at the frigid temperature of liquid nitrogen or below.

4. shock – *удар, поражение*

short circuiting – *короткое замыкание*

Plastic coating are frequently found covering copper wires to protect the user from shock and keep devices from short circuiting.

5. knob – *ручка, кнопка*

pole – *столб, шест*

Ceramic knobs are used where electrical wires are attached to utility poles or to the back of a house.

6. to dominate – *преобладать*

compound – *соединение, состав*

Silicon – based materials dominate in the semiconductor industry

and in electronic devices like computers and calculators, but a number of other compounds are also used extensively.

7. to exhibit – *показывать, демонстрировать*

to possess – *владеть, обладать*

In the readings and lab activities that follow, the emphasis is on what semiconductor materials are, how they are used, what properties they possess, and why they behave as they do.

Task 170. Fill in the gaps with the correct variants:

1. A very few ceramic compounds have . . . . . the unusual property of superconductivity at the frigid temperature of liquid nitrogen or below.

a) abandoned b) exhibited c) developed d) acquired

2. Plastic coatings are frequently found covering copper wires to . . . . . the user from shock and keep devices from short circuiting.

a) escape b) prevent c) protect d) deliver

3. Ceramic knobs are used where electrical wires are . . . . to utility poles or to the back of a house.

a) attached b) wound c) stretched d) twisted

4. A number of the other compounds are also used . . . . . including GaAs (or gallium arsenides) which is the material used in the laser of a CD player.

a*) accordingly b) moderately c) occasionally d) extensively*

5. In the readings and lab activities that follow, the emphasis is on what semiconductor materials are, how they are used, what properties they . . . . . , and why they behave as they do.

a) cause b) improve c) possess d) imply

Task 171. Sum up the text using the following plan:

1. Properties of conductors.
2. Properties of insulators.
3. Properties of semiconductors.
4. Application of conductors, insulators and semiconductors.
5. Chemical elements possessing semiconductor properties.

ACTIVITY 5: VOCABULARY WORK AND DISCUSSION

Task 172. Explain the meaning of the following words and word combinations:

Dimension, conductor, insulator, to heat, opaque, to mount, behavior, resistant, to transfer.

Task 173. Translate the following sentences into Russian without using a dictionary:

1. Physical dimensions also impact conditionally.

2. Materials with high electron mobility are called conductors, while materials with low electron mobility are called insulators.

3. Materials that easily conduct light are called “transparent”, while those that don’t are called “opaque”.

4. Conductive object are often mounted upon insulating object.

5. The behaviour of an object, which has been charged, is dependent upon whether the object is made of a conductive or a non-conductive material.

Task 174. Define the meanings of the following words using English-English dictionary. The first example is given to you.

1. resistant – *not damaged or affected by smith*
2. transparent –
3. distribution –
4. plastic coatings –
5. to handle –

Task 175. Fill in the gaps. Decide which meaning is the correct one in the given sentences.

1. ..... is determined by the types of atoms in a material.

a) conductivity b) influence c) heat

2. Materials with low electron mobility are called….

a) conductors b) insulators c) carriers

3. Most metals become poor conductors when .....

a) cooled b) heated c) melted

4. Physical ..... has an influence on conductivity.

a) shape b) property c) function

5. Gases, such as air, becomes conductive if ..... to very high temperatures.

a) heated b) warmed c) increased

Task 176. For the words given in A column find the Russian equivalent in B column.

A	B
to float	нагревать
dimension	изолятор, диэлектрик
to heat	внедрить; установить
transparent	размер
behaviour	двигаться плавно
insulator	поведение
to install	ускорить
to facilitate	прозрачный

DISCUSSION

In groups of four discuss the following problems. Share your answers with the whole group.

1. A conductor is often mounted on top of an insulator. Do you think that this arrangement helps student's or teacher's work?
2. Why are some materials called "opaque"?
3. What happens with conductivity of different materials when heated?
4. How does conductivity of different materials change when their temperatures decrease?

OUTCLASS ACTIVITY

Task 177. Read the text and give the written translation using your dictionary. Pay attention to the participial constructions.

TEXT 5.5:
INSULATORS

1. An electrical insulator resists the flow of electricity. Application of a voltage difference across a good insulator results in negligible electrical current. In comparison, a conductor allows current to flow readily. Controlling the flow of current in electrical wiring and electronic circuits requires both insulators and conductors. For example, wires typically consist of a current-carrying metallic core sheathed in an insulating coating. Resistivity is the measure of a material's effectiveness in resisting current flow.

2. Materials with resistivities higher than 10 Ohm/m are usually considered to be good insulators; these include glass, rubber, and many plastics. Resistivities as high as 1016 ohm-m can be achieved in exceptional insulating materials. Normal conductors may have resistivities as low as 10^{-8} ohm-m. The enormous variation in room-temperature resistivity is one of the largest for any physical attribute of matter.

3. The charge carriers responsible for current in most conductors are electrons, moving relatively freely in a metal. In insulators, electrons cannot move freely. When atoms of simple metals combine to form a solid, the outer valence electrons become free for conduction. In an ideal insulator, all electrons stay tightly bound to the atoms, so there are no

electrons that can be readily moved through the material for conduction.

4. A more complete understanding of insulators and conductors requires consideration of electronic band structure. The electrons in an isolated atom possess discrete energies, a consequence of quantum mechanics. These discrete levels evolve into bands of allowed energies when the atoms condense into a solid. Forbidden regions separate the allowed bands, as shown schematically in the figure. The electrons in the solid fill in the bands, from lower to higher energy.

5. The distinction between an insulator and a conductor lies in how the electrons fill in the allowed bands. For a simple metal, the highest band containing electrons will be only half full. The thermal energy (at ordinary temperatures) will be sufficient to generate conduction electrons – electron states of slightly higher energy are available in the incompletely filled band.

6. In comparison, the highest energy band containing electrons is completely full in a good insulator. The thermal energy of the electrons is not sufficient for promotion from this band, known as the valence band, to the next band with available energy states, known as the conduction band. The gap between the valence and conduction band, known as the band gap, is at least several electron-volts (eV) wide in an insulator – thermal electron energies are 100 times smaller.

7. The distinction between an insulator and a semiconductor is one of degree. Although both have completely filled valence bands at eV, the band gap of a semiconductor is smaller than an insulator. For narrower band gaps, thermal energy is more capable of promoting electrons into the conduction band.

8. Insulators play a critical role in many aspects of technology, from large scale to the microscopic. Electrical power transfer relies on high voltage transmission lines for which insulators are required to prevent losses to ground. High voltage transformers rely on special insulating oils. Dielectric materials enhance the charge storage of a capacitor. Even bits of information in a computer memory require thin insulators in the form of oxide layers in increasingly smaller transistor circuits.

Task 178. Sum up the text according to the following plan:

1. The property of resistivity.
2. The behaviour of electrons in an insulator.
3. Electronic band structure.
4. The distinction between an insulator and a semiconductor.
5. The role of insulators in industry and technology.

APPENDIX A – Information about annotation of precis

ЧТЕНИЕ

Чтение – это первичная обработка письменной информации. В зависимости от цели, чтение бывает: (1) просмотровое (skimming reading); (2) ознакомительное (average reading); (3) изучающее или углубленное (study or close reading); (4) поисковое (scanning reading).

При просмотровом чтении прежде всего определяется, к какой области познаний относится данная информация, и отбирается интересующий материал. Потом по заглавию, выходным данным, схемам, таблицам, рисункам и подписям к ним, подзаголовкам, аннотации, по первому и последнему абзацам определяется основная тема текста (subject-matter). Далее выделяются ключевые слова, ключевые предложения и основные мысли в абзацах (параграфах). Этот вид чтения предполагает быстрый просмотр текста про себя.

При ознакомительном чтении (чтении с общим охватом содержания) происходит знакомство с информацией, заключенной в тексте, с целью понимания общего смысла читаемого. При этом виде чтения выделяется главное, а второстепенное исключается, обобщаются факты, сопоставляются отдельные части текста, а также ведется поиск смысловой структуры, выделяются ключевые слова и предложения, как и при просмотровом чтении. Это чтение для себя.

Изучающее чтение имеет целью полное понимание смысла читаемого текста. Это вдумчивое, тщательное чтение. Грамматический анализ отдельных предложений может помочь при затруднении в понимании смысла читаемого. Здесь также предполагается нахождение ключевых слов и предложений. Этот вид чтения может происходить вслух и про себя.

С целью нахождения какого-либо факта, цитаты, фамилии и т. п. проводится беглый просмотр текста с помощью поискового чтения. Этот вид чтения также осуществляется про себя.

Соответствующие приемы чтения применяются всякий раз, когда необходимо выбрать именно тот режим чтения, который соответствует цели чтения, характеру читаемого текста и времени, отводимому для чтения.

Параграф или абзац (a paragraph) – это часть текста, имеющая самостоятельное значение и начинающаяся с новой строки. В нем заключена определенная, законченная мысль. Отрывок (a passage) - это часть текста, состоящая из нескольких параграфов. Не всегда параграф (абзац) совпадает с логической частью или единицей (a logical part or

unit) текста. Логическая часть текста, в свою очередь, может состоять из нескольких параграфов. В ней может идти речь об описании какого-либо предмета, события, явления, процесса и т. п. Ключевые слова (key words) - это слова, несущие основную смысловую нагрузку. В английском языке это чаще всего существительные. Ключевые (тематические) предложения (topic sentences) передают основную мысль параграфа и обычно помещаются в начале его.

Научно-техническая статья обычно состоит из следующих частей:

1. Заголовок (Title). 2. Аннотация (Abstract or Summary). 3. Введение (Introduction). 4. Общая часть (Methods, Materials, Procedures). 5. Результаты, обсуждение результатов, заключение (выводы) и рекомендации (Results, Discussions, Conclusion, Recommendations). 6. Благодарности (Acknowledgements). 7. Использованная литература (References, Literature, Bibliography).

АННОТИРОВАНИЕ

Аннотирование – это вторичная обработка письменной информации. Для того чтобы зафиксировать краткое содержание произведения, пишется аннотация. Аннотация (Abstract или Summary) - это краткая справка о статье, патенте, книге, справочнике и т. п. с точки зрения содержания. При аннотировании печатный материал излагается в предельно сжатой форме. Это процесс свертывания (сжатия) информации с очень большим уменьшением по отношению к оригиналу (до 1/10 его части).

Аннотации бывают описательные, справочные, реферативные, рекомендательные и критические. Студентам в учебном процессе для обработки печатной информации на иностранном и русском языках, при оформлении записок к дипломным проектам, необходимо умение составлять описательные аннотации. Специалисты и ученые также должны уметь писать аннотации к своим научным статьям, докладам и материалам для конференций, на книги и т. д.

Описательная аннотация состоит из трех частей:

1. Справка к аннотации. В ней указываются следующие данные: автор; название работы на английском языке, перевод названия; количество страниц, таблиц, рисунков, ссылок на использованную литературу; на каком языке дописана работа. Кроме того, для журнала - его название на английском языке, номер и год издания; для патентов - номер патента и страна патентования; для каталогов - фирма, выпустившая данный каталог; для книг, монографий, учебников - название издательства. Эта часть не обязательна при аннотировании учебных текстов.

2. Основная часть должна отражать перечень наиболее характерных положений по содержанию работы.

3. Заключительная часть. В этой части должен быть общий вывод автора работы или указание на один какой-то вопрос, которому в работе уделено особое внимание, а также рекомендация, для кого данная работа может представлять особый интерес.

К аннотациям, как на русском, так и на английском языке предъявляются следующие требования:

1. Лаконичность языка, т.е. использование простых предложений (глаголы употребляются всегда в настоящем времени в действительном или страдательном залоге. Модальные глаголы, как правило, отсутствуют).

2. Строгая логическая структура текста аннотации.

3. Обязательное введение в текст аннотации безличных конструкций и отдельных слов, например: «Сообщается...», «Подробно описывается...», «Кратко рассматривается...», «Излагаются...», «Комментируются...» и др., с помощью которых происходит введение и описание текста оригинала.

4. Недопущение повторений в заглавии и тексте аннотации.

5.Точность в передаче заглавия оригинала, отдельных формулировок и определений.

6. Использование общепринятых сокращений слов, таких как: напр., и т.д., и т.п., и др.

7. Единство терминов и обозначений.

Текст аннотации должен быть максимально кратким, от 500 до 1000 печатных знаков.

Основные штампы (key-patterns) аннотаций на английском и русском языках:

1. The article (paper, book, etc.) deals with...	1. Эта статья (работа, книга и т. д.) касается...
2. As the title implies the article describes...	2. Согласно названию, в статье описывается...
3. It is specially noted...	3. Особенно отмечается...
4. A mention should be made...	4. Упоминается...
5. It is spoken in detail...	5.Подробно описывается...
6. ...are noted.	6. Упоминаются...
7. It is reported...	7. Сообщается...
8. The text gives a valuable information on...	8. Текст дает ценную информацию...
9. Much attention is given to...	9. Большое внимание уделяется...
10. The article is of great	10. Эта статья окажет большую

help to...	помощь...
11. The article is of interest to...	11. Эта статья представляет интерес для...
12. It (the article) gives a detailed analysis of...	12. Она (статья) дает детальный (подробный) анализ...
13. It draws our attention to...	13.Она (статья, работа) привлекает наше внимание к...
14. The difference between the terms... and... should be stressed.	14. Следует подчеркнуть различие между терминами...и...
15. It should be stressed (emphasized) that...	15. Следует подчеркнуть, что..
16. ...is proposed.	16.Предлагается...
17. ...are examined.	17. Проверяются (рассматриваются)...
18. ...are discussed.	18. Обсуждаются...
19. An option permits...	19. Выбор позволяет...
20. The method proposed... etc.	20. Предлагаемый метод... и т. д.

Первые два штампа в основном используются при устном аннотировании и кратком изложении содержания оригинала.

Чтобы составить аннотацию статьи, нужно ознакомиться с ее заголовком, просмотреть подзаголовки, иллюстрации, таблицы, прочитать введение и заключение; достаточно одноразового просмотра статьи, т. е. просмотрового чтения. При этом следует иметь в виду, что конкретная тема научно-технического текста обычно излагается в первом или одном из начальных предложений введения и реже заключения.

APPENDIX B – ACRONYMS

AGC (Automatic Gain Control) – Circuit employed to vary gain or amplifier in proportion to input signal strength so that output remains at a constant level.

ALE (Automatic Link Establishment) – A technique that permits radio stations to make contact with one another automatically.

AM (Amplitude Modulation) – A technique used to transmit information in which the amplitude of the radio frequency carrier is modulated by the audio input and the full carrier and both sidebands are transmitted.

AME (Amplitude Modulation Equivalent) – A method of single sideband transmission where the carrier is reinserted to permit reception by conventional AM receivers.

ARQ (Automatic Repeat Request) – Data transmission technique for error-free data transfer.

ASCII (American Standard Code for Information Interchange) – The standard code for digital data interchange. ASCII uses a coded character set consisting of a 7-bit coded character (8 bits including parity check).

BER (Bit Error Ratio) – The number of erroneous bits divided by the total number of bits communicated.

BLOS (Beyond Line-of-Sight) – Communications that occur over a great distance.

CCIR (International Radio Consultative Committee) – An organization of the International Telecommunications Union (ITU) that studies technical questions related to radio communications.

CW (Continuous Wave) – A radio wave of constant amplitude and constant frequency. Also, Morse code.

dB (Decibel) – The standard unit for expressing transmission gain or loss and relative power ratios.

DSP (Digital Signal Processing) – A recently developed technology that allows software to control digital electronic circuitry.

DTMF (Dual-Tone-Multi-Frequency) – Refers to DTMF signaling, which is typically used in telephone systems.

EMI (Electromagnetic Interference) – An electromagnetic disturbance that degrades communications performance. Synonym: Radio Frequency

Interference (RFI).

ERP (Effective Radiated Power) – Equivalent power transmitted to the atmosphere, which is the product of the transmitter power output multiplied by the gain of the antenna.

FEC (Forward Error Correction) – A system of error control for data transmission whereby the receiver can correct any code block that contains fewer than a fixed number of bits in error.

FM (Frequency Modulation) – A form of modulation where the frequency of a carrier varies in proportion to an audio modulating signal.

FOT (Frequency of Optimum Transmission) – The highest frequency predicted to be available for sky wave transmission for a given path and time for 85 percent of the maximum usable frequency (MUF).

FSK (Frequency Shift Keying) – A form of modulation in which a digital signal shifts the output frequency between discrete values.

LOS (Line of Sight) – A term that refers to radio signal propagation in a straight line from the transmitter to a receiver without refraction; generally extends to the visible horizon.

LPD (Low Probability of Detection) – Techniques for minimizing the probability that the transmitted signal is detected by an unauthorized party.

LPI (Low Probability of Intercept) – Techniques for minimizing the likelihood of the intelligence on a transmitted signal being recovered by an unauthorized party.

LQA (Link Quality Analysis) – A technique for real-time channel evaluation in which radios measure and store values indicating the relative quality of a radio link at different assigned frequencies.

LUF (Lowest Usable Frequency) – The lowest frequency in the HF band at which the received field intensity is sufficient to provide the required signal-to-noise ratio.

MFSK (Multi-tone Frequency Shift Keying).

MUF (Maximum Usable Frequency)–The upper limit for the frequencies used at a specified time for radio transmission between two points via ionospheric propagation.

HF (High Frequency) – Nominally, the band from 3 to 30 MHz; in practice, the lower end of the HF band extends to 1.6 MHz.

Hz (Hertz) – Basic unit for frequency.

IF (Intermediate Frequency) – A frequency used within equipment as an intermediate step in transmitting or receiving.

IONCAP (Ionospheric Communications Analysis and Prediction) – A popular and effective propagation prediction program that predicts system performance at given times of day as a function of frequency for a given HF path and a specified complement of equipment.

NVIS (Near-Vertical Incidence Sky wave) – A technique for transmitting over relatively short ranges by ionospheric refraction using very high incident angles.

OHM Unit of measurement of resistance. Its symbol is W.

OTAR (Over-The-Air-Re keying) – This technique developed by Harris eliminates the need for manual loading of encryption keys and provides a more secure method of key management.

RAU (Remote Access Unit).

SNR (Signal-to-Noise Ratio) – The ratio of the power in the desired signal to that of noise in a specified bandwidth.

RMS (Root Mean Square).

ISB (Independent Sideband) – Double sideband transmission in which the information carried by each sideband is different.

RTCE (Real-Time Channel Evaluation) – Techniques used to select frequencies, adjust data rates, or change modulation schemes in adaptive radio systems.

SATCOM (Satellite Communications).

SSB (Single Sideband) – A modulation technique in which the carrier and one sideband (upper or lower) are suppressed so that all power is concentrated in the other sideband.

TEK (Traffic Encryption Key) – Used in digital encryption.

TIU (Telephone Interface Unit).

APPENDIX C – GLOSSARY

ABSORPTION, n, the extraction of energy, usually from a wave. A radio carrier wave is absorbed by many materials, resulting in the conversion of the absorbed energy into heat or some other form of energy. The alternatives to absorption are transmission, reflection and refraction.

ADAPTIVE EXCISION FILTER A signal-processing technique that improves data transmissions. It seeks and suppresses narrow band interference in the demodulator input and reduces the effects of co-channel interference (interference on the same channel that is being used).

ADAPTIVE SYSTEM A system that automatically adjusts its parameters to improve its performance in response to changing conditions.

AMPLITUDE The peak-to-peak magnitude of a radio wave.

ANTENNA COUPLER/TUNER A device between the transmitter and antenna that modifies the characteristics of the load presented to the transmitter so that it transfers maximum power to the antenna.

ANTENNA DIRECTIVE GAIN The ratio of radiation intensity in a certain direction to the average radiation intensity.

ANTENNA POWER GAIN The ratio of radiated power in a given direction to the antenna input power.

ASYMMETRICAL KEY SYSTEM A key management system that allows two-way secure communications among all users that have a public key and a private key.

ASYNCHRONOUS A data communication system that adds start-and-stop signal elements to the data for the purpose of synchronizing individual data characters or blocks.

ATMOSPHERIC NOISE Radio noise caused by natural atmospheric processes (primarily by lightning discharges in thunderstorms).

AUTOMATIC CHANNEL EQUALIZER A signal processing technique that improves data transmissions by compensating for variations in the channel characteristics as data is received.

BANDPASS FILTER A filter that passes a limited band of frequencies. It is used to remove noise and spurious signals generated in the exciter or output frequency harmonics from the power amplifier.

BANDWIDTH The range of frequencies occupied by a given signal.

BASEBAND The frequency band occupied by a signal prior to radio frequency carrier modulation or following demodulation.

BAUD A unit of signaling speed equal to the number of symbols, i.e., discrete signal conditions per second.

BINARY Number system having base of 2, using only the symbols 0 and 1.

BIT One binary digit (0 or 1).

BROADBAND A term indicating the relative spectrum occupancy of a signal as distinguished from a narrow band signal. A broadband signal typically has a bandwidth in excess of twice the highest modulating frequency. Synonym: Wide-band.

BURST, n a few cycles of signal.

CARRIER A radio frequency signal that may be modulated with information signals.

CHARGE, n. the fundamental property of the electron (negative charge) and proton (positive charge). The recognizable and measurable feature of charge is that one charge will exert force on any other charge. The relationship was discovered by Charles Coulomb, after whom the modern unit of charge is named. One Coulomb (which equals 6.24184 x 10^{18} electrons) is the charge which, one metre from an equal charge in a vacuum, repels it with a force of 8.9874 x 10^{9} newtons.

CHANNEL A unidirectional or bi-directional path for transmitting and/ or receiving radio signals.

CIPHER TEXT Encrypted data.

COLLOCATION The act or result of placing or arranging side by side.

COSMIC NOISE Random noise originating outside the earth's atmosphere.

CRYPTOGRAPHY A COMSEC technique that translates (encrypts) information into an apparently random message and then interprets (deciphers) the random message by decryption.

D LAYER First layer in the ionosphere. Reaches maximum ionization when the sun is at zenith and dissipates quickly toward sunset.

DE-INTERLEAVING Process used by a demodulator to reverse

interleaving and thus correct data transmission errors used in FEC coding.

DEMODULATION The process in which the original modulating signal is recovered from a modulated carrier.

DIPOLE ANTENNA A versatile antenna that is usually a wire fed at the center of its length. Its orientation provides either horizontal or vertical polarization.

DIRECT WAVES Travel in straight line, becoming weaker as distance increases.

DIRECTIONAL ANTENNA An antenna that has greater gain in one or more directions.

E LAYER The mid-level of the ionosphere which reaches maximum ionization at noon. It begins dissipating toward sunset and reaches minimum activity at midnight. Irregular cloud-like formations of ionized gases occasionally occur in the E layer.

ENCRYPTION Process of translating information into an apparently random message.

ERROR DETECTION An error correction technique that uses binary code words to modify data messages by systematically adding check bits to detect errors in received words.

EXCITER The part of the transmitter that generates the modulated signal for a radio transmitter.

F LAYER The uppermost and most heavily ionized region of the ionosphere. Important for long-haul communications, since this layer remains ionized even after sunset.

FADING The variation of the amplitude and/or phase of a received signal due to changes in the propagation path with time.

FREQUENCY The number of completed cycles per second of a signal, measured in hertz (Hz).

FREQUENCY HOPPING The rapid switching (hopping) of radio system frequency for both the receiver and transceiver from frequency to frequency in apparently random patterns, using a common timing reference.

GAIN The ratio of the value of an output parameter, such as power, to its input level. Usually expressed in decibels.

GROUND REFLECTED WAVE The portion of the propagated wave that is reflected from the surface of the earth between the transmitter and receiver.

GROUND WAVE A radio wave that is propagated over the earth and ordinarily is affected by the presence of the ground.

IMPEDANCE Opposition to current flow of a complex combination of resistance and reactance. Reactance is the opposition to AC current flow by a capacitor or an inductor. An ideal antenna coupler will act so as to cancel the reactive component of antenna impedance, i. e., by providing an equal inductive reactance if the antenna has a capacitive reactance or an equal capacitive reactance if the antenna presents an inductive reactance.

INCIDENT ANGLE The angle at which sky waves enter the ionosphere.

INTERLEAVING A technique that increases the effectiveness of FEC codes by randomizing the distribution of errors in communication channels characterized by error bursts.

IONOSPHERE A region of electrically charged particles or gases in the earth's atmosphere extending from 50 to 600 kilometers (approximately 30 to 375 miles) above the earth's surface.

IONOSPHERIC SOUNDING An automated propagation prediction technique.

JAMMING Deliberate interference that results from transmission on operating frequencies with the intent to disrupt communications.

KEY A variable that changes the mathematical algorithm in cryptography.

KEY GENERATOR A device or process that generates the variable for a cryptographic encoding system.

MAIN LOBE In an antenna radiation pattern, the lobe containing the direction of maximum radiation intensity.

MODEM (MOdulator-DEmodulator) – A device that modulates and demodulates signals. The modem converts digital signals into analog form for transmitting and converts the received analog signals into digital form.

MODULATION The process, or result of the process, of varying a characteristic of a carrier in accordance with a signal from an information source.

MULTTPATH The propagation phenomenon that results in radio signals reaching the receiving antenna by two or more paths.

MULTTPATH SPREAD The range of timed differences that it takes for radio signals to reach the receiving antenna when they arrive from several routes, which may include one or more sky wave paths and/ or a ground-wave path. The effect of multipath spread is minimized by selecting a frequency as close as possible to the MUF.

OMNIDIRECTIONAL ANTENNA An antenna whose pattern is non-directional in azimuth.

ON-OFF KEYING Turning the carrier on or off with telegraph key (Morse code). Same as CW.

PARALLEL TONE MODEM Carries information on simultaneous audio tones, where each tone is modulated at a low-keying rate.

PHASE In a periodic process such as a radio wave, any possible distinguishable state of the wave.

POLARIZATION The orientation of a wave relative to a reference plane. Usually expressed as horizontal or vertical in radio wave terminology.

POWER AMPLIFIER The part of the transmitter that boosts the output power of the radio signal to the desired wattage before sending it to the transmitting antenna.

PREAMBLE A known sequence of bits sent at the start of a message which the receiver uses to synchronize to its internal clock.

PROPAGATION The movement of radio frequency energy through the atmosphere.

PUBLIC KEY CRYPTOGRAPHY A type of key management system used in the commercial sector. Under this standard, each user generates two keys, a public key and a private key. The strength of such a system lies in the difficulty of deriving the private key from the public key.

RADIATION PATTERN Pattern determined by an antenna's design and strongly influenced by its location with respect to the ground. Radiation patterns are frequency dependent.

REFRACTION The bending of a radio wave as it passes obliquely from one medium to another.

SCRAMBLING A COMSEC technique that involves separating the voice signal into a number of bands, shifting each band to a different audio

frequency range, and combining the resulting bands into a composite audio output that modulates the transmitter.

SERIAL TONE MODEM Carries digital information on a single audio tone.

SHORTWAVE Radio frequencies above 3 MHz.

SID (Sudden Ionospheric Disturbance) – Abnormally high ionization densities caused by solar flares, resulting in a sudden increase in radio wave absorption.

SIDEBAND The spectral energy, distributed above or below a carrier, resulting from a modulation process.

SKY WAVE A radio wave that is reflected by the ionosphere.

SOFT-DECISION DECODING An error-correction technique where a group of detected symbols that retain their analog character are compared against the set of possible transmitted code words. A weighing factor is applied to each symbol in the code word before a decision is made about which code word was transmitted.

SPORADIC E Layer found in the E Layer of the ionosphere. Supports propagation of sky waves at the upper end of the HF band and beyond.

SPREAD SPECTRUM A technique used to overcome deliberate radio communications interference, in which the modulated information is transmitted in a bandwidth considerably greater than the frequency content of the original information.

STORE AND FORWARD A technique where information is stored until a communication link is established and then sent.

SUNSPOT CYCLE Eleven-year cycle of sunspots which generate bursts of radiation that increase levels of ionization.

SURFACE WAVES Travel along the surface of the earth and may reach beyond the horizon.

SYMMETRIC KEY SYSTEM A key management system in which the

same key encrypts and decrypts data.

SYNCHRONOUS A form of data communications that uses a preamble to alert the data receiver that a message is coming and to allow it to synchronize to an internal bit clock.

TAKE-OFF ANGLE The angle between the axis of the main lobe of an

antenna pattern and the horizontal plane at the transmitting antenna.

TRAFFIC The information moved over a communications channel.

TRANSCEIVER Equipment using common circuits in order to provide transmitting and receiving capability.

TRANSEC (Transmission Security) – Techniques that prevent signal detection or jamming of the transmission path.

VERTICAL WHIP ANTENNA An omnidirectional antenna that has low take-off angles and vertical polarity.

VOCODER A device that converts sounds into a data stream that can be sent over an HF channel. Short for voice coder-decoder.

WAVELENGTH Distance between point on loop of wave to corresponding point on adjacent wave.

VOCABULARY

ADAPTIVE EXCISION FILTER – *адаптивный режекторный фильтр*
Метод обработки сигнала, улучшающий передачу данных. Ищет и подавляет узкополосные помехи на входе демодулятора и снижает воздействие внутриканальных помех (помех в используемом канале).
ADAPTIVE SYSTEM – *адаптивная система*
Система с автоматической подстройкой параметров с целью улучшения собственных характеристик при изменении условий.
AGC (Automatic Gain Control) *– АРУ (автоматическая регулировка усиления)*
Схема, применяемая для регулировки усилителя пропорционально мощности входного сигнала, таки образом, что выходной сигнал поддерживается на постоянном уровне.
ALE (Automatic Link Establishment) – *АУС (автоматическое установление связи)*
Метод, позволяющий станциям беспроводной связи устанавливать связь друг с другом автоматически.
AM (Amplitude Modulation) – *АМ (амплитудная модуляция)*
Метод, применяемый для передачи информации, в которой амплитуда несущей модулируется аудио входом, причем передаются и полная несущая, и обе боковые полосы.
AME (Amplitude Modulation Equivalent) *– ЭАМ (эквивалент амплитудной модуляции)*
Метод передачи одиночной боковой полосы при котором несущая восстанавливается для обеспечения приема обычными ЧМ приемниками.
AMPLITUDE *– амплитуда*
Расстояние между пиками волны.
ANTENNA COUPLER/TUNER *– устройство связи антенна/тюнер*
Устройство, расположенное между передатчиком и антенной, которое изменяет характеристики нагрузки передатчика для передачи на антенну максимальной мощности.
ANTENNA DIRECTIVE GAIN *– прямое усиление антенны*
Интенсивность излучения в определенном направлении относительно средней мощности излучения антенны.
ANTENNA POWER GAIN *– усиление мощности антенны* Излучаемая мощность в определенном направлении относительно к входной мощности антенны.
ARQ (Automatic Repeat Request) *– АПЗ (автоматический перезапрос).*
Метод передачи данных для обеспечения безошибочной передачи.
ASCII (American Standard Code for Information Interchange) –

код ASCII (американский стандарт кода для обмена информацией) Стандарт кода для обмена цифровыми данными. В ASCII применяется набор кодовых знаков, состоящий из 7-битных закодированных знаков (8 бит, включая проверку на паритетность).

ASSYMETRICAL KEY SYSTEM *– асимметричная система ключей* Система управления ключами, обеспечивающая двустороннюю безопасную связь между всеми пользователями, имеющими общедоступный ключ и личный ключ.

ASYNCHRONOUS – *асинхронный*

Система передачи данных с добавление начальных и конечных компонентов сигнала к данным для синхронизации отдельных знаков или блоков данных.

ATMOSPHERIC NOISE *– атмосферный шум*

Радио шум, вызванный естественными атмосферными процессами (обычно разрядами молний в грозу).

AUTOMATIC CHANNEL EQUALIZER *– автоматический эквалайзер канала*

Метод обработки сигнала, улучшающий передачу данных путем компенсации отклонений характеристик канала при приеме данных.

BANDPASS FILTER *– полосовой фильтр*

Фильтр, пропускающий ограниченную полосу частот. Применяется для удаления шума и случайных сигналов, генерируемых возбудителем, или выходных частотных гармоник усилителя мощности.

BANDWIDTH – *ширина полоса*

Диапазон частот, занимаемых отдельным сигналом.

BASEBAND *– полоса пропускания*

Полоса частот, занимаемая сигналом до модуляции несущей радиочастоты или последующей демодуляции.

BAUD – *бод*

Единица скорости передачи сигнала, равная количеству символом, т.е., условие дискретного сигнала в секунду.

BER (Bit Error Ratio) *– СБО (скорость битовой ошибки)* Количество ошибочных битов, поделенное на общее количество передаваемых битов.

BINARY *– двоичный*

Численная система по основанию 2, где используются только символы 0 и 1.

BIT *– бит*

Одна двоичная цифра (0 или 1).

BLOS (Beyond Line-of-Sight) – *(вне прямой видимости)* Связь на дальнее расстояние.

BROADBAND – *широкая полоса*

Относительная занятость спектра сигналом, по определению относительно узкополосного сигнала. Широкополосный сигнал обычно

имеет полосу, вдвое превышающую наиболее высокую частоту модуляции. Синоним: Wideband.

CARRIER *– носитель, связь, несущая данных*

Радиочастотный сигнал, который может модулироваться информационными сигналами.

CCIR (International Radio Consultative Committee) – CCIR *(Международный консультативный, комитет по беспроводной связи)*

Организация в составе Международного телекоммуникационного Союза (ITU), изучающая технические вопросы, относящиеся к связи.

CHANNEL *– канал*

Однонаправленный или двунаправленный путь передачи и/или приема радиосигналов.

CIPHER TEXT – *закодированный текст*

Кодированные данные.

COLLOCATION *– размещение*

Процесс или результат размещения двух сторон.

COMSEC (Communication security) – *(безопасность связи)*

Методы скремблирования или криптографии, делающие информацию недоступной для понимания неавторизованными пользователями.

COSMIC NOISE *– космический шум*

Случайный шум, возникающий за пределами земной атмосферы.

CRYPTOGRAPHY *– криптография*

Метод COMSEC, состоящий в преобразовании (шифрации) информации в кажущиеся случайными сообщения и последующей интерпретации (дешифрации) этих сообщений.

CW (Continuous Wave) *– НВ (непрерывная волна)*

Радиоволна с постоянной амплитудой и частотой, также известная как код Морзе.

D LAYER *– слой D*

Первый слой ионосферы. Достигает максимальной ионизации при положении солнца в зените и быстро исчезает на закате.

dB (Decibel) *– дБ (децибел)*

Стандартная единица выражения усиления или ослабления передачи и относительных коэффициентов мощности.

DE-INTERLEAVING *– деперемежение*

Процесс в демодуляторе, состоящий в обратном перемежении и корректировании ошибок передачи данных, применяемый в FEC кодировании.

DEMODULATION *– демодуляция*

Процесс, при котором первоначальный модулирующий сигнал восстанавливается из модулированной несущей.

DIPOLE ANTENNA *– вибраторная антенна*

Многоцелевая антенна, обычно использующая проводной фидер по центру своей длины. В зависимости от ориентации возможна

горизонтальная или вертикальная поляризация.

DIRECT WAVES *– прямые волны.*

Проходят по прямой линии, ослабевают при увеличении расстояния.

DIRECTIONAL ANTENNA *– направленная антенна*

Антенна, имеющая большее усиление в одном или более направлениях.

DSP (Digital Signal Processing) – *ЦОС (Цифровая обработка сигналов)*

Недавно разработанная технология, позволяющая программному обеспечению контролировать цифровые электронные схемы.

DTMF (Dual-Tone-Multi-Frequency) *– DTMF (множественная частота с двойным тоном)*

Относится к DTFM сигналам, обычно применяемым в системах телефонии.

E LAYER *– слой E*

Промежуточный уровень ионосферы, достигающий максимальной ионизации в полдень. Начинает исчезать к закату и достигает минимальной активности в полночь. В этом слое могут появляться скопления, ионизированных газов, выглядящие как неправильной формы облака.

EMI (Electromagnetic Interference) *– ЭМП (электромагнитные помехи)*

Электромагнитные возмущения, ухудшающие характеристики связи.

ENCRYPTION *– кодирование*

Процесс преобразования информации в кажущееся случайным сообщение.

ERP (Effective Radiated Power) *– ЭОМ (эффективно отраженная мощность)*

Эквивалентная мощность, передаваемая в атмосферу, которая является произведением выходной мощности передатчика на усиление антенны.

ERROR DETECTION *– детектирование ошибок*

Метод коррекции ошибок, применяющий слова двоичного кода, для изменения сообщений данных путем систематического прибавления проверочных битов для детектирования ошибок в принятых словах.

EXCITER – *возбудитель*

Часть передающего оборудования, генерирующая модулированный сигнал для радиопередатчика.

F LAYER *– слой F*

Самый верхний, наиболее ионизированный участок ионосферы, имеет большое значение для дальней связи, т.к. ионизация в нем сохраняется и после заката солнца.

FADING *– затухание (фединг)*

Отклонения амплитуды и/или фазы принятого сигнала вследствие изменения условий распространения во времени.

FEC (Forward Error Correction) *– ОКО (опережающая коррекция ошибок)*
Система контроля ошибок при передаче данных, причем приемник может корректировать любой блок кода, который содержит ошибок менее фиксированного их количества.
FM (Frequency Modulation) *– ЧМ (частотная модуляция)*
Форма модуляции, при которой частота несущей изменяется в пропорции к модулирующему аудио сигналу.
FOR (Frequency of Optimum Transmission) *– частота оптимальной передачи*
Наибольшая частота, доступная для передачи по определенному лучу и в определенном временном интервале при 85% максимально используемой частоты.
FREQUENCY *– частота*
Количество полных циклов сигнала в секунду, измеряемая в герцах (Гц).
FREQUENCY HOPPING *– скачкообразная перестройка частоты*
Синхронизированное быстрое переключение (скачок) частоты в радиосистеме как приемника, так и приемопередатчика с частоты на частоту по кажущей случайной схеме.
FSK (Frequency Shift Keying) *– ввод сдвига частоты*
Форма модуляции, при которой цифровой сигнал сдвигает выходную частоту между дискретными значениями.
GAIN – *усиление*
Коэффициент значения выходного параметра, такого как мощность, относительно входного уровня. Обычно выражается в децибелах.
GROUND REFLECTED WAVE *– отраженная от поверхности земли волна*
Часть распространенной волны, которая отражается от поверхности земли на пути между передатчиком и приемником.
GROUND WAVE *– наземная волна*
Радиоволна, распространяемая над поверхностью земли.
HF (High Frequency) *– ВЧ (высокая частота)*
Номинальная полоса 3 ... 30 МГц, на практике нижняя граница ВЧ полосы доходит до 1,6 МГц.
Hz (Hertz) *– Гц (Герц)*
Основная единица частоты.
IF (Intermediate Frequency) *– ПЧ (промежуточная частота)* Частота, используемая в оборудовании для промежуточного шага между передачей или приемом.
IMPEDANCE *– импеданс*
Противоположность текущему потоку сложных комбинаций сопротивления и реактивного сопротивления. Реактивное сопротивление является противоположностью потоку переменного напряжения в конденсаторе или индукторе. Идеальное антенное

устройство работает таким образом, чтобы подавлять реактивную компоненту импеданса антенны, т.е., путем обеспечения равного индуктивного реактивного сопротивления, если антенна имеет емкостное реактивное сопротивление, либо аналогичного емкостного реактивного сопротивления, если антенна показывает индуктивное реактивное сопротивление.

INCIDENT ANGLE *– угол падения*

Угол вхождения радиосигнала в атмосферу.

INTERLEAVING *– перемежение*

Метод, повышающий эффективность FEC кодирования путем рандомизации распределения ошибок в каналах связи при наличии передачи ошибочных пакетов.

IONCAP (Ionospheric Communications Analysis and Prediction) – *АПИС (анализ и прогнозирование ионосферной связи)*

Популярная и эффективная программа прогнозирования распространения, предсказывающая системные характеристики в определенное время дня в зависимости от частоты для определенного ВЧ луча и относительно определенного оборудования.

IONOSPHERE – *ионосфера*

Слой электрически заряженных частиц или газов в атмосфере Земли, протяженностью от 50 до 600 км над поверхностью земли.

IONOPHERIC SOUNDING *– ионосферное зондирование*

Метод прогнозирования автоматического распространения.

ISB (Independent Sideband) *– НБП (независимая боковая полоса)*

Передача по двойной боковой полосе, причем по каждой боковой полосе передается информация, отличная от той, которая передается по другой боковой полосе.

JAMMING – *наведенная помеха*

Намеренные помехи, наведенные на рабочие частоты для искажения связи.

KEK (Key Encryption Key) *– ключ шифрования ключей, клавиша ключа шифрования*

Применяется в цифровом шифровании.

KEY – *ключ*

Переменная, изменяющая математический алгоритм в криптографии.

KEY GENERATOR – *генератор ключей*

Устройство или процесс формирования переменных для криптографической системы кодирования.

LOS (Line of Sight) – *ЛПВ (линия прямой видимости)*

Термин, относящийся к распространению радиосигнала по прямой линии от передатчика к приемнику без рефракции; обычно простирается до линии горизонта.

LPD (Low Probability of Detection) *– НВД (низкая вероятность детектирования)*

Методы минимизации вероятности несанкционированного обнаружения переданного сигнала.

LPI (Low Probability of Intercept) *– НВП (низкая вероятность перехвата)*

Методы минимизации вероятности несанкционированного распознавания переданного восстанавливаемого сигнала.

LQA (Link Quality Analysis) *– АКС (анализ качества связи)*

Метод реальной оценки канала, в котором радиостанции измеряют и запоминают значения, обозначающие относительное качество радиоканала при различных частотах.

LUF (Lowest Usable Frequency) *– (наименее используемая частота)*

Наименьшая частота ВЧ-полосы, при которой интенсивность принятого поля достаточна для обеспечения требуемого отношения сигнал/шум.

MAIN LOBE *– основной лепесток (антенны)*

Лепесток антенной излучающей диаграммы, содержащий направление максимальной интенсивности излучения.

MFSK (Multi-tone Frequency Shift Keying) *– многотоновая манипуляция.*

MODEM (MOdulator-DEmodulator) *– модем*

Устройство, модулирующее и демодулирующее сигналы. Модем преобразует цифровые сигналы в аналоговую форму и принятые аналоговые сигналы в цифровые.

MODULATION *– модуляция*

Процесс или результат процесса изменения характеристик несущей в соответствии с сигналом информационного источника.

MUF (Maximum Usable Frequency) *– наиболее используемая частота*

Верхний предел частот, используемых в определенное время для радиопередачи между двумя точками по ионосфере.

MULTIPATH *– многолучевость*

Феномен распространения, результатом которого поступление радиосигналов на приемную антенну по двум или более лучам.

MULTIPATH SPREAD *– задержка многолучевости*

Диапазон временной разницы, необходимый для радиосигналов для поступления на принимающую антенну, когда они проходят по различным трактам, включающим один или более луч волн, отраженных от верхних слоев атмосферы, и/или наземных волн. Эффект задержки многолучевости минимизируется выбором частоты, по возможности близкой к MUF.

NVIS (Near-Vertical Incidence Sky wave) *– почти вертикальное падение волны, отраженной от верхних слоев атмосферы*

Метод передачи на относительно короткое расстояние посредством ионосферной рефракции при использовании большого угла падения.

OHM *– Ом*

Единица измерения сопротивления. Символ – Ω

OMNIDIRECTIONAL ANTENNA – *всенаправленная антенна* Антенна, диаграмма направленности которой не направлена к азимуту.

ON-OFF KEYING – *амплитудная манипуляция*

Включение или выключение несущей посредством телеграфного ключа (морзянка). Тоже, что CW.

OTART (Over-The-Air-Rekeying) – *метод, разработанный Harris, устраняет необходимость в ручной загрузке ключей кодирования и обеспечивает большую точность управления ключами.*

PARALLEL TONE MODEM – *модем с параллельным тоном* Переносит информацию на одновременных аудио тонах, причем каждый тон модулируется на низкой скорости.

PHASE – *фаза*

Любое возможное отличительное состояние волны в периодическом процессе, таком как, радиоволна.

POLARIZATION – *поляризация*

Ориентация волны относительно эталона. Обычно бывает горизонтальной или вертикальной в терминологии радиопередачи.

POWER AMPLIFIER – *усилитель мощности*

Часть передатчика, которая усиливает выходную мощность радиосигнала до требуемой мощности до отправки его на передающую антенну.

PREAMBLE – *преамбула*

Известная последовательность битов, переданных в начале сообщения, которые использует приемник для синхронизации.

PROPAGATION – *распространение*

Движение энергии радиочастоты в атмосфере.

PUBLIC KEY CRYPTOGRAPHY – *криптография с открытым ключом* Тип систем управления ключами, используемых для коммерческих целей. В соответствии со стандартом каждый пользователь генерирует два ключа, открытый и закрытый (секретный). Достоинство такой системы – сложность извлечения закрытого ключа из открытого.

RADIATION PATTERN – *схема излучения*

Схема, определяемая конструкцией антенны, на которую сильно влияет местоположение относительно земли. Схемы излучения зависят от частоты.

RAU (Remote Access Unit) – *УУД (устройство удаленного доступа)*

REFRACTION – *отражение*

Искривление радиоволны при ее прохождении перпендикулярно среде.

RMS (Root Mean Square) – *среднеквадратический.*

RTCE (Real-Time Channel Evaluation) – *ОКРВ (оценка канала в реальном времени)*

Методы, используемые для выбора частот, регулировки скоростей данных, выбора схем модуляции в адаптивной радиосистеме.

SATCOM (Satellite Communications) – *СС (спутниковая связь)*

***SCRAMBLING** – скрембпирование*
Метод COMSEC, включающий разделение голосового сигнала на ряд полос, перенос каждой полосы на различную аудиочастоту, объединение результирующей полосы в составной аудиовыход, который модулирует передатчик.
***SERIAL TONE MODEM** – модем с последовательным тоном* Переносит цифровую информацию на одном аудио тоне.
***SHORT WAVE** – короткая волна* Радиочастота выше 3 МГц.
***SID (Sudden Ionospheric Disturbance)** – ВАВ (внезапные атмосферные возмущения)*
Аномальная высокая плотность ионизации, вызванная солнечными вспышками, которые являются результатом внезапного увеличения абсорбции радиоволн.
***SIDEBAND** – боковая полоса*
Спектральная энергия, распределенная выше или ниже несущей. Является результатом модуляции.
***SKY WAVE** – радиоволна, отраженная ионосферой.*
***SNR (Signal-to-Noise Ratio)** – ОСШ (Отношение сигнал-шум)*
Отношение мощности полезного сигнала к мощности шума в определенной полосе частот.
***SOFT-DECISION DECODING** – декодирование с мягкими решениями*
Метод коррекции ошибок, когда группа обнаруженных символов, сохраняющих свой аналоговый характер, сравниваются относительно набора возможных переданных кодовых слов. Фактор взвешивания подается на каждый символ кодового слова до вынесения решения, какое кодовое слово передано.
***SPORADIC E** – спорадический Е-слой*
Обнаруженный в слое ионосферы Е. Поддерживает распространением волн, отраженных от верхних слоев атмосферы при верхнем значении ВЧ-диапазона и выше.
***SPREAD SPECTRUM** – расширение спектра*
Метод, применяемые для преодоления намеренных помех, при котором модулированная информация передается в полосе частот, значительно превышающей полосу частот первоначальной информации.
***SSB (Single Sideband)** – с одной боковой полосой*
Метод модуляции, когда несущая и одна боковая полоса (верхняя или нижняя) подавляются так, чтобы вся мощность концентрировалась в одной боковой полосе.
***STORE AND FORWARD** – запомни и направь, передача с промежуточным сохранением*
Метод, при котором информация сохраняется до установки связи и затем отправляется.
***SUNSPOT CYCLE** – цикл солнечных пятен*

Одиннадцатилетний цикл солнечных пятен, когда формируются пакеты излучения, превышающих уровень ионизации.

SURFACE WAVES *– поверхностная волна*

Проходит над поверхностью земли и может достигнуть горизонта.

SYMMETRIC KEY SYSTEM *– система с использованием симметричного ключа*

Система управления ключами, когда те же ключи шифруют и дешифруют данные.

SYNCHRONOUS *– синхронный*

Форма передачи данных, использующая преамбулу для предупреждения передатчика о приеме сообщения и обеспечения синхронизации с внутренней синхронизацией.

TAKE-OFF ANGLE *– угол раскрывания, угол выхода*

Угол между лучом главного лепестка диаграммы направленности антенны и горизонтальной плоскостью передающей антенны.

TEK (Traffic Encryption Key) *– ключ кодирования трафика* Используется в цифровой шифрации.

TIU (Telephone Interface Unit) *– интерфейсный блок телефона* ***RAFFIC*** *– информация, проходящая по каналам связи.* ***TRANSCEIVER*** *- приемопередатчик*

Оборудование, использующее общие схемы, для обеспечения передачи и приема.

TRANSEC (transmission Security) *– безопасность передачи* Методы, предотвращающие обнаружение сигналов или их подавление в лучах передачи.

VERTICAL WHIP ANTENNA *– вертикальная (гибкая) штыревая антенна*

Всенаправленная антенна, имеющая малый угол раскрывания и вертикальную поляризацию.

VOCODER *– Вокодер*

Устройство, конвертирующее звуки в поток данных, который можно передать по ВЧ-каналу. Краткое обозначение устройства кодирования/декодирования голоса.

WAVELENGTH *– длина волны*

Расстояние между точкой петли волны и соответствующей точкой соседней волны.

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Каширский Сергей Николаевич
Аленькова Наталья Валерьевна
Комарова Эмилия Павловна
Балашов Юрий Степанович

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