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Радиотехника

Учебные задания

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Учебные задания содержат тексты по теме «Радиотехника» и различные виды упражнений для развития навыков чтения и перевода научно-технической литературы, реферирования и аннотирования.

Разработаны на кафедре иностранных языков в соответствии с требованиями программы по английскому языку для неязыковых специальностей вузов и предназначены для студентов 2 курса V факультета.

Печатаются по решению редакционно-издательского совета Самарского Государственного аэрокосмического университета имени С.П. Королева.

Рецензент О.Н. Маринина

Unit 1

The Maser

1. Просмотрите текст и разделите его на смысловые части.
2. Озаглавьте каждую часть.

THE MASER

The maser is a device which amplifies microwave signals by making use of the radiation emitted when transitions occur between energy states in atoms or molecules. The name derives from "Microwave Amplification by Stimulated Emission of Radiation".

According to the principles of quantum physics, atoms or molecules may exist in any one of a number of discrete energy states. Most of the atoms or molecules will exist in the lowest or ground state, but they may be raised to any of the possible higher states by causing them to absorb radiation of frequency. Conversely, molecules or atoms in a higher state, on transferring to a lower state, will emit radiation of frequency/ depending on the difference in energy between the states in the same way. Such transitions from higher to lower states may also be induced by applying a small amount of radiation of frequency. If it were possible to prepare a material in which more molecules existed in the higher energy state than in the lower, the application of a small amount of radiation of the correct frequency would cause more downward than upward transitions. There would thus be a net emission of radiation at this frequency and consequent amplification of the applied signal. This is the essential principle of maser action.

The first maser constructed used ammonia gas. This can exist in two possible energy states, the difference between which corresponds to a frequency of 24,000 Mc/s. Molecules in the higher energy state may be separated from those in the lower energy state by placing them in an electrostatic field, since those in the higher state are repelled while those in the lower state are attracted by such a field. Thus if a beam of ammonia molecules traverses such a field in a cylinder, only those in the higher energy state will emerge, the lower-energy-state molecules being attracted to the walls of the cylinder. The emerging beam is then fed into a cavity resonator tuned to 24,000 Mc/s and subjected to a small signal of this frequency. Transitions to the lower state are thus induced and energy is given to the microwave signal. Such a device, called a two-level maser, can easily be adapted to oscillation.

The signal from the ammonia maser is stable to one part in 10^{10}, and it can thus be used as a frequency or time standard. As an amplifier, however, its disadvantage is that it has virtually no band-width, since it can only amplify a signal of 24,000 Mc/s. Masers using solid-state materials (artificial ruby being a commonly used substance) can, however, be tuned by subjecting them to a magnetic field, which alters the energy difference between states and thus gives a limited range of frequency operation.

Three-level masers have also been constructed. In these, materials having three possible energy levels Wu W_2 and W_s are used. The material is first subjected to radiation corresponding to the difference thus transferring the substance from its ground state to the higher stateW3. By applying a small signal of frequency transitions from W_a to JF_2 occur, with the emission of radiation of this frequency and consequent amplification of the applied signal. Using potassium cobalti-cyanide containing 0-5 per cent of chromium as maser material and applying 1 m W of "pumping" power at 9,000 Mc/s, 30 dB gain at 3,000-Mc/s signal has been obtained.

Such masers must be operated at extremely low temperatures to be successful and are normally surrounded with a liquid helium bath. Under such conditions they have a very low noise level; noise figures as low as 0-1 dB have been achieved. Such low-noise operation is far in advance of anything obtainable with conventional amplifiers.

In typical microwave maser amplifier using solid material the maser material is contained in a cavity resonator designed to resonate at both the pump and signal frequencies, and is held between the poles of a magnet. There it is subjected to both the pump and signal fields. This arrangement is known as a reflection-type maser, since the input and output signals enter and leave along the same wave-guide. To separate the input and output signals from one another a ferrite circulator is used. The circulator is a device in which power can travel from one arm to the adjacent arm in one direction only, as shown. Thus the input signal can only enter the cavity arm, and the output from the cavity can only enter the output arm. The circulator also serves to isolate the maser from any reflections arising from the output load impedance, these reflections being absorbed in the matched load.

Transmission-type masers, in which separate arms are used for the input and output to the cavity, have also been constructed. In this case ferrite isolators must be used in each arm to protect the maser from any reflected power.

Masers which use only a single cavity are of necessity narrow-band devices; in order to overcome this limitation the travelling-wave maser has been developed. This operates by slowing down the signal wave to allow it to interact with the maser material over a longer period.

The cavity is dispensed with and a slow-wave structure with the maser material mounted in it is used. The pump and signal frequencies are fed in at one end of the slow-wave structure and the amplified signal is obtained at the other end. An isolator in the structure and cooling in liquid helium are required as before. Using this principle, an amplifier having ruby as maser material has been constructed at 6,000 Mc/s which gives 23 dB gain, has a band-width of 25 Mc/s and a noise figure of only 0-16 dB. A pump power of 100 mW at 19,000 Mc/s is used.

Due to the low noise level of maser amplifiers, they are finding increasing application in receiving systems where the incoming signal is very small, e.g., in radio-astronomy and radar. By using a maser as the first stage, practically noise-free amplification is obtained, further amplification being provided by a conventional amplifier.

A 4170 Mc/s travelling-wave maser developed by Mullard for the Goonhilly satellite ground-station (see Section 20) has a net forward gain of 39 dB, a bandwidth of 16 Mc/s, a noise temperature of 15^{л}4° K., with a pump frequency of 30,150 Mc/s and an operating temperature of 1.4° K.

3. Закончите следующие предложения:

a) Atoms and molecules may exist in …

b) Masers using solid-state materials can …

c) In a typical microwave maser amplifier using solid materials …

d) Due to the low noise level of maser amplifiers …

e) Ferrite isolators must be used in each arm of transition type to …

4. Составьте план текста.

5. Напишите аннотацию к тексту, пользуясь следующими речевыми моделями:

This article is concerned with …

It is shown that …

Special attention is given to …

… are described in short.

It should be noted that …

The following conclusions are drawn.

6. Письменно переведите текст "The Laser"

The Laser

The mechanism of maser action is not confined to microwaves and can, in principle, be applied in any part of the electromagnetic spectrum, provided suitable materials are available and a workable system can be designed. Intensive development of such devices in the visible and infra-red regions of the spectrum is being carried out. Such " optical masers ", or " lasers " as they are now generally called, are not so much light amplifiers as coherent light sources, i.e., they produce a wave train of practically pure monochromatic light. Conventional light sources are mostly incoherent, i.e., the light emitted by them contains random phase changes which have the effect of broadening the frequency spectrum of the emitted light. The coherent nature of the laser output has two important consequences, namely, the light can be focused into a very narrow beam with little spread and the beam can be modulated to carry information like a radio wave. Due to the high directivity communication over enormous distances with quite modest power can be achieved, and since very high modulation frequencies can be used with a light carrier practically unlimited bandwidth is obtainable. These properties give the laser immense potentialities in the communications field.

Today lasers have been constructed using solids and gases as emitting materials. The material is "pumped" to a higher energy state by means of an intense incoherent light source and the material, in transferring to a lower energy state, emits a coherent beam of monochromatic light. Suitable focusing arrangements are used to obtain the emitted light in the form of a narrow beam.

Although lasers are still in the early stages of development, preliminary results indicate that optical radar systems using laser sources are capable of ranges of several hundred miles using only a few watts of power. Interplanetary communication over distances of millions of miles is regarded as a feasible future application.

Unit 2

“Electrical Interference”

1. Просмотрите текст и разделите его на смысловые части.
2. Озаглавьте каждую часть.

Electrical Interference

Electrical interference with reception must be carefully considered in almost all branches of radio and television engineering; for example, in domestic entertainment, interference levels play a large part in determining the effective service areas of broadcast and television transmitters; in land, sea and air mobile operation much attention has to be paid to the suppression of engines and auxiliary equipment; in point-to-point communications, receiving stations are usually located in the country to avoid the higher interference levels prevalent in urban areas.

Electrical apparatus which utilizes commutation (e.g., D.C. motors and generators), vibrating contact points (e.g., electric shavers), spark discharge (e.g., automobile ignition) or any mechanism whereby an electric spark, however minute, is produced will radiate damped radio-frequency waves, covering a wide frequency spectrum, unless preventive measures are taken. Certain other electrical appliances may also radiate radio-frequency energy. Radiations of either type may be rendered audible by a radio receiver in the form of continuous crackling, sporadic clicks, buzzing or humming noises, a number of which are characteristic of the source causing the trouble.

Some of the more common sources of electrical interference are : Industrial generators and electric motors, vacuum cleaners, hair dryers, sewing-machine motors, barbers' clippers, farm and dairy machinery, automatic switches and contactors, thermostats, overhead power tines, trolley-bus systems, defective house/factory wiring and switches, lifts, automobile ignition systems, R.F. heating and welding plant, X-ray, ultra-violet ray and diathermy plant, commercial, Service and amateur transmitters, broadcast and television receivers, scraping contacts between metallic objects at differing potentials, door-bells, fluorescent lighting, cash registers, electric typewriters, mercury-arc rectifiers and so on. A number of these, such as diathermy apparatus and automobile ignition systems, are only likely to cause disturbance on short-wave ranges. Corona discharge from high-voltage cables and static-charged wires may, in certain atmospheric conditions, give rise to a high background noise, particularly noticeable on S. W. Static-charged rain may also prove troublesome.

Direct Radiation from the Source. Except for electro-medical apparatus and car interference on H.F. and V.H.F., radiation is likely to occur only over a comparatively short range, especially on the broadcast bands. Arcing between the collector and overhead wires of trolley buses or between the shoes and rails of electric trains may, however, cause interference by direct radiation to programmes transmitted on medium and long wavebands.

Conducted Interference. This is probably the most frequent path of transmission on M. W. and L.W. The electrical disturbances are conducted along the power-supply lines and injected into the receiver by way of the mains lead.

Mains-radiated Interference. Similar to conducted interference, except that in this case the power-supply leads form a kind of transmitter aerial, the radiations from which are picked up by the aerial or the internal wiring of the broadcast receiver. Both conducted and mains-radiated interference may be borne by the power lines over considerable distances, in extreme cases, affecting an entire district.

Secondary Radiation. Similar to the above, except that two direct radiation links occur and the transmission line may take the form of telephone wiring, neighbouring aerials, gas and water pipes and so on.

Interference can be received in three ways: (1) pick-up by the aerial and lead-in wires; (2) injection into the receiver via the mains supply leads; and (3) by stray electric fields. Apart from cause (2), both mains-operated and battery-operated receivers can be equally affected.

BROADCAST RECEIVER INTERFERENCE

In order to reduce or eliminate interference, it is necessary:

(1) To ascertain the path by which the interference reaches the receiver.

(2) To identify, wherever possible, the source of interference and to ensure that adequate suppression is applied.

(3) Failing this, or where complete suppression at the source is not practicable, to fit interference filters at the receiver, or close to the receiver end of the path.

The manner in which the interference reaches the receiver can usually be ascertained by carrying out a few simple tests, though it should be noted that, in practice, a combination of two or more routes is not uncommon.

(1) Remove the aerial and earth leads from the receiver and short-circuit the appropriate sockets. Directly radiated and mains-radiated interference should then cease altogether or be greatly reduced, whereas mains-conducted interference may be hardly, if at all, affected.

(2) Test the relative strength of interference under no-signal conditions at the high- and low-frequency ends of each waveband. Directly radiated interference tends to increase as the wavelength decreases, and will usually be much increased in strength on the short wavebands. Disturbances from mains-conducted interference, on the other hand, will normally become stronger as the wavelength is increased and be most troublesome on the long waveband.

(3) If a battery-operated receiver be available, the effect of switching off the electric power at the main house switchboard should be noted. Should the interference continue it is unlikely that mains-borne radio-frequency signals are the cause. If the interference ceases, it would seem that interference is entering the premises via the mains supply wiring, or alternatively, that the source of interference is located within the premises concerned.

Identifying the Source of the Trouble

Often the interference source will be obvious or easily traced from the characteristic nature of the disturbance and from observation of the times at which it is experienced. The source of directly radiated interference is normally restricted to within a radius of a few hundred feet of the receiver.

More troublesome causes may be traced with the assistance of a portable battery receiver, preferably fitted with a frame aerial, so that rough bearings of the source of interference can be plotted. These bearings should always be taken by observing points of minimum signal strength, which occur when the axis of the frame aerial is at 90° to the direction of the source; readings taken on maximum pick-up are considerably less accurate. Portable receivers, which have no frame aerial, can be used by simple observation of the strength of the interference, provided that it is possible to move freely within the search area.

Mains-borne and mains -radiator) interference, which may originate at a considerable distance from the receiver, may prove much more difficult to trace; it will not be possible to pinpoint the direction of the source until the search has been narrowed to the area within which directly radiated interference can be received. The effect of removing the fuses, one at a time, from each of the house circuits and of switching off the power at the main switchboard should be noted: this procedure will usually establish whether or not the interference is arising from defective switches, cable joints or apparatus within the building. Where mains-borne interference originates outside the premises and the source is not obvious, it will usually be necessary to obtain assistance from the Engineering Branch of the G.P.O., who have developed specialized techniques for tracing elusive sources of interference.

3. Закончите следующие предложения:

a) Radio – frequency energy is radiated by …

b) Some examples of electrical interference sources are …

c) There exist such kinds of interference as …

d) To reduce interference we should …

e) Interference can be received …

4. Выпишите предложения, необходимые для включения в аннотацию.

5. Составьте аннотацию.

6. Переведите последнюю часть текста, начинающуюся со слов “Identifying the source of the Trouble”.

7. Расскажите кратко по-английски о текстах, определяющих способ восприятия интерференции приемником.

Unit 3

“Reliability”

1. Прочитайте статью, выделите в ней основные разделы и озаглавьте первый раздел.

Reliability

There has been a constant striving to improve reliability on the part of set manufacturers and component manufacturers alike. The improvements have been more marked in the export than the home field, because tropical climates necessitate much greater attention to this subject. Improvements in the reliability of individual components are discussed later. Reliability, however, also depends on careful choice of the most suitable components and materials by the set manufacturer and on the way they are used. The following are examples of this:

(1) Capacitors are liable to breakdown or to cause trouble through developing too low an insulation resistance unless chosen with care. For example, the chassis/earth capacitor in a live-chassis receiver must be capable of continuous operation at the A.C. mains voltage. Similarly, a capacitor coupling the anode of one valve to the grid of the next can cause a damaging positive voltage to appear on the grid if its insulation resistance ever falls too low.

(2) Resistors must be chosen so that their wattage ratings are not exceeded, care being taken to relate these to the ambient temperature. If a resistor's ambient temperature is unusually high, the normal wattage rating will be too high a figure to take: neglect of this precaution may lead to premature failure.

(3) Other components that may suffer through insufficient attention to the effects of heat are electrolytic capacitors, metal rectifiers, mains transformers, and even valves, which although designed to run hot, need adequate ventilation, especially power valves and rectifiers.

(4) The set's performance may suffer due to the effects of heat on the oscillator-circuit components and intermediate-frequency transformers, causing frequency

drift and necessitating irksome re-tuning of the receiver at intervals as the set warms up. Apart from attention to ventilation, spacing with respect to very hot components, and careful choice of material for coil formers and switch insulation, etc., drift may be reduced by the use of negative temperature coefficient capacitors.

The money saved by an auto-transformer is negligible, however, if a mains filter, an earth terminal and pick-up sockets are fitted. This somewhat surprising result is due to the cost of the mains filter, the isolating capacitor for the earth terminal, three isolating capacitors plus a resistor for the pick-up sockets and other extra items needed as a result of live-chassis or live bus-bar technique. These include: a current-limiting resistor for the rectifier valve; a by-pass capacitor for the rectifier valve to prevent modulation hum; and the aerial isolating capacitor. Apart from economic considerations, the mains auto-transformer is very useful in a small receiver, where the production of heat in voltage-dropping resistors would be troublesome, provided that operation on D.C. mains is not required; for example, in a small mains or mains/battery receiver in a thermoplastic cabinet.

Improved designs have reduced the intrinsic cost of some components. Several also contribute to overall economy because their reduced size results in smaller chassis, and, if desired, smaller cabinets. Examples of these are valves, ganged variable capacitors, intermediate-frequency transformers and electrolytic capacitors.

Size of Chassis and of Receivers

The reduction in the sizes of components has permitted the use of smaller, lighter, chassis. This in turn has meant that very small receivers can be made, and, even where for acoustic or appearance reasons a larger cabinet is desired, the chassis may occupy but a small portion of the total volume of the cabinet.

Small receivers have become increasingly important. Some are mains operated, but many including the very small" pocket" portables weighing only about 8 oz, are battery operated and fully transistorized. The battery economy possible with transistors has made valves battery and mains/battery sets practically obsolete from a design viewpoint. Transistor receivers are discussed separately at the end of this Section.

Safety

There have been determined efforts by manufacturers to improve the safety of their receivers during the last few years, and the British Standard dealing with this subject (B.S. 415) has recently been revised.

The following is a brief review of the principles involved in B.S. 415, together with examples of practical measures which may be employed.

B.S. 415 Recommendations

The receiver must be so designed and constructed that there is no risk of serious electric shock or danger of fire either in normal use or under fault conditions, e.g., breakdown of insulation, the accidental touching of two metal parts or their bridging by another metal part.

To ensure this, tests have to be carried out both under normal use (including those conditions of mains voltage, receiver signal conditions, external connections and control settings most likely to cause trouble) and with faults deliberately created, e.g., by short-circuiting insulation, unless this is so good that it can be considered completely free from the possibility of breakdown.

Practical measures of design and construction include the following examples

(1) The receiver housing should be such that it is impossible to bring a finger close to a live part, ("Live" being either under normal or fault conditions; the revised E.S. 415 describes a standard test" finger" of hinged construction, and its use.)

(2) Adequate clearance and creepage distances should be maintained between conductors, which are not at substantially the same potential.

(3) Insulating material used in components and in the receiver generally should be of good quality.

{4} The leakage current which can flow to earth from any terminals accessible to the customer should be so small that no more than small harmless shocks occur if the terminals are touched or wires connected to them are held. The aerial leakage current is a special case, since a man working on a ladder might lose his balance by receiving only a very small shock, and a particularly low limit has to be set here. This limit determines the maximum value of an aerial-isolating capacitor, and the minimum value of a static discharge resistor (see below) if this be connected to a live conductor, either direct or through a sufficiently large capacitance.

(5) The aerial terminal should be provided with a D.C. leakage path in order to prevent breakdown of isolating components by the accumulation of static charges.

(6) It should not be possible to touch a live part with a plug or wire when trying to insert or connect it.

(7) Under normal or fault conditions the temperature of components should remain low enough for flames, sustained arcs or smouldering not to develop. Current and/or temperature fuses may be used to achieve this. It will often be found that more fuses than one are required, and great care is necessary in choosing the types and ratings of fuses and their positions in the circuit. This is because it is easy to choose a current fuse that will blow when a short-circuit develops, but it may be found that this also blows with switching-on surges. Examples of surges when switching on are those occurring in the primary circuit of a mains transformer, in the supply circuit of a rectifier followed by a reservoir capacitor (switching on when either cold or warm with a metal rectifier or when warm with a valve rectifier), and in the supply circuit of a chain of series-run valve heaters (when cold).

Quality of Reproduction

Improvements in quality of reproduction have taken place chiefly in high-fidelity receivers, the markets for which are in general small because of their necessarily high cost and because the receiver and its loudspeaker occupy too much space for the average householder.

High-fidelity reproduction is discussed in Section 37.

In ordinary mass-produced domestic receivers there have been a few improvements, however. These include: loudspeakers; pick-ups and recordings;

negative feedback; compensated volume control; and the reduction of cabinet boom.

The low-price mass-produced loudspeaker has improved; how this affects broadcast receivers is described later.

2. Выделите ключевые фрагменты каждого раздела статьи.
3. Выделите предложения, которые помогут вам кратко изложить содержание первого раздела.
4. Обобщите и максимально сократите второй и третий разделы статьи.
5. Прочитайте часть статьи со слов “Practical measures of design and construction…” и охарактеризуйте тематику, полноту и новизну сообщающихся сведений.
6. Определите практическую ценность статьи.
7. Прочитайте первый раздел статьи до слов “Size of Chassis and of Receivers” и составьте к нему вопросы.
8. Перефразируйте, измените, упростите и по возможности сократите следующие предложения или их части:

a) “The improvement have been more marked …”

b) “Resistors must be chosen so ..”

c) “There have been determined efforts by manufacturers...”

d) “The receiver must be so designed and constructed…”

e) “Improvement in quality of reproduction have taken place…”

9. Сформулируйте выводы статьи.
10. Напишите аннотацию статьи, используя следующие речевые модели:

The main idea of the article is …

The fact … is stressed.

It is pointed out that …

It showed be remembered that …

There is no doubt that …

Unit 4

"Radio – Frequency Transmission Lines"

1. Прочтите статью и ответьте на вопросы:

a) What can be done to convey energy in the form of electro – magnetic waves of high frequency?

b) What factors should be taken into consideration when defining the requirements of a transmission line?

c) What is a perfectly matched (согласованная) system?

d) What are the basic requirements for transmission lines?

e) What kinds of transmission lines are described in the text?

RADIO-FREQUENCY TRANSMISSION LINES

In order to convey energy in the form of electro-magnetic waves of high frequency from one place to another it is possible to:

(a) Radiate the energy, perhaps directionally.

(b) Guide the wave by using, generally, some metallic structure such as a hollow waveguide, or a surface waveguide, or by guiding the energy as a transverse electromagnetic wave by a pair of metallic conductors. This last technique finds application at all frequencies up to about 10,000 Mc/s, and is the method, which will be considered here.

Qualitative Considerations

To appreciate the basic requirements of a transmission line comprising two conductors, consider first the case of energy transfer in the form of DC. Here, under steady state conditions, it is well known that:

(a) the only characteristic of the transmission line which is of interest is its total resistance, which should be small compared with load resistance;

(б) maximum energy transfer to the load will occur when the load resistance is equal to the internal resistance of the generator (strictly speaking plus the resistance of the line).

Considering now the case where AC. is flowing in the line, as the frequency is increased it becomes necessary to take into account both the capacitance between the two conductors and also their self-inductance. At sufficiently high frequencies the inductance and capacitance of the line influence the transmission considerably, and under these conditions the input impedance of an infinitely long, uniformly constructed line is not infinity but a pure resistance of numerical value $\sqrt{(L/C)}$, and known as the characteristic impedance, Z_0, of the line, where L - self-inductance of line, henrys/unit length, and C — capacitance of line, farads/unit length.

The Need for Impedance Matching

By analogy with the D.C. case considered above, maximum energy transfer will occur when the generator supplies a load of resistance equal to the generator output resistance. This condition would be fulfilled by, for example, an oscillator of 70 ohms output resistance feeding an infinitely long transmission line of 70 ohms characteristic impedance. Conditions would be unaltered by feeding instead a finite length of line terminated in a 70-ohm resistive load, say a resonant dipole aerial of 70 ohms radiation resistance.

Physically, the effect of a change in impedance in a transmission-line system is to produce partial reflection of the electromagnetic wave, and hence a reduction in the energy absorbed by the load. A perfectly matched system is one in which the transmitted wave leaves the generator and arrives at, and is absorbed by, the load with no net reflection. It will be seen later when matching methods are considered that it is possible to convert a mismatched system to a matched one by arranging to add further reflections to cancel those already existing.

PRACTICAL TRANSMISSION LINES

Two general fundamental requirements may be stated as follows:

(1) The transmission line must be a uniform structure with the properties constant along its length. This becomes increasingly important at the higher frequencies and for electrically long lines, particularly in such applications as television transmission, where multiple internal reflections due to changes of characteristic impedance along the length of the line may produce picture distortion or even loss of energy transfer.

(2) The energy absorbed by the line should be small. Some loss is inevitable, due to the resistance of the conductors and the power factor of the dielectric separating them, but the loss may be made small by using highly conducting metals such as copper and aluminium, and low-loss, low-permittivity dielectrics such as polyethylene (polythene), polystyrene, or, better still, air. The line must be of adequate size to carry the requisite power without overheating.

Balanced (Twin) Line

The simplest form of practical line comprises two parallel conducting wires, held at a constant spacing by suitable means. A convenient cable construction of this form comprises two conductors embedded in a flat extruded ribbon of polythene. Such cables are used on systems the terminals of which are balanced with respect to earth (e.g., dipole aerials).

Unbalanced (Co-axial) Lines

If the "balanced line is imagined to be rotated about one conductor the result is a co-axial system, which is essentially unbalanced with respect to earth. A simple example would be a single copper wire, covered with an extruded cylindrical coating of polythene and enclosed within a tube of aluminium.

2. Обобщите содержание каждой части статьи, представив каждую 1-2 предложениями.
3. Переведите письменно предложения, в которых говорится о требованиях, предъявляемых к линиям передач.
4. Подумаете и решите, можно ли использовать какую-либо часть статьи как аннотацию к ней.

5. Составьте свою аннотацию.

Unit 5

1. Дайте перевод заголовка статьи на русский язык.

V.H.F. TRANSMITTER-RECEIVER EQUIPMENT

MULTI-CHANNEL SYSTEMS

An important application of V.H.F. radio is its use to replace telephone cables in undeveloped regions or over difficult terrain, such as rivers, valleys or forests. Several speech channels, up to forty-eight in number, can be accommodated on one radio circuit. The separate speech signals are first combined by means of channeling equipment to give a traffic channel, which requires a band-width of 12-204 kc/s to accommodate forty-eight channels to C.C.I.F. standards.

The simplest multi-channel system consists of two terminal equipments, linking two telephone exchanges. When a long transmission path is involved, repeaters must be used. Frequency modulation is invariably used for multi-channel equipment in the V.H.F. band, and at repeaters the F.M. carrier can be frequency changed to an intermediate frequency, amplified and frequency changed again to the new transmitter frequency, without de-modulation. This system avoids cross-modulation between speech channels, introduced by modulator and de-modulator circuits at repeaters. For some systems however, when the number of repeaters is small, the repeaters may take the form of two terminal equipments with through connections.

The signal input required at each receiver in a system depends on the number of telephone channels, the signal-to-noise ratio required for each telephone channel, and the number of repeaters used in the system. The maximum distance between repeaters is very little more than optical range, so that careful siting of stations is required.

Transmitter powers are usually about 20 watts, but powers up to 100 watts are occasionally used. The aerial arrays are generally horizontally polarized Yagis.

Four frequencies are required at each repeater, and common aerial working is usually employed to reduce the number of aerials and masts, the transmitter and receiver operating in a given direction sharing the same aerial.

Since repeaters often operate unattended for long periods between inspection visits, reliability of the equipment is of prime importance. Facilities are provided to enable the repeaters to be checked from the terminal stations by loop tests, and facilities are sometimes provided for automatic change-over to stand-by equipment in the event of a fault developing at a repeater.

Terminal Transmitters

Modulation may be direct F.M., or by means of a phase modulator with a correcting network to give effective frequency modulation. If a phase modulator is used, the initial phase deviation must be kept very low, since distortion in the modulating process will produce cross-modulation between speech channels. The deviation corresponding to the necessarily small phase swing is consequently also very low, of the order of 1,000 c/s. As a deviation of about 300 kc/s is required at the radiated frequency, there must be considerable multiplication between the output of the modulator and the final power-amplifying stages. To avoid the use of an unduly low crystal frequency, different harmonics of the crystal, one modulated and one unmodulated, are mixed to produce a signal at crystal frequency with increased deviation.

2. Прочтите текст и выделите основную мысль каждого абзаца.

3. Напишите план текста.

4. Прочтите начало аннотации, дополните и завершите ее.

This paper looks at v.h.f. multi-channel systems used nowadays to replace telephone cables in regions where the use of cables proves to be difficult. The author gives a description …

5. Переведите последний абзац текста письменно (время выполнения – 15 минут).

Unit 6

Cathode – Ray Tubes

1. Прочтите текст, найдите и переведите предложения, в которых содержаться ответы на вопросы:

a) What is the sphere of application of cathode-ray tubes?

b) What were the shortcomings of gas-focused tubes?

c) What are cathode rays?

d) What was the contribution of A. Dufour into the development of cathode-ray tubes?

CATHODE-RAY TUBES

The cathode-ray tube, together with its associated time-bases and amplifiers, is now to be found in almost every branch of electronic and scientific work. Recent years have seen many advances in the design and construction of the electron gun, while the rapid development of television has made necessary the mass-production of tubes with large screens. Gas-focused tubes, which suffered from comparatively short life and excessive spot-swelling when the beam current was increased, have now been superseded by the high-vacuum types in which pressures lower than 10"^{6} mm. Hg are attained.

The apparatus used for early experiments has little in common with the modern cathode-ray tube, but the pioneers did succeed in establishing certain basic principles which paved the way for subsequent development.

The cathode-ray tube is named after Hittorf's discovery in 1868 of " cathode rays ", although since J. J. Thomson's investigations in 1879 it is now known that the once mysterious " cathode ray " consist of electrons travelling at extreme speed from a negative electrode towards parts of the tube at positive potential; a more correct name would therefore be " electron beam ".

It has been known since 1868 that the cathode rays could be deflected by magnets. A. Hess was the first to propose their use for oscillographic purposes, but this was realized for the first time by Ferdinand Braun in 1897. The Braun Tube was evacuated to a pressure of a few bars. Its gas fining was usually nitrogen. At a pressure of this order, the electronic pencil left the finest trace. Two years later Wiechert proposed to make it finer by a magnetic coil, termed the "concentrating coil". Such tubes were used for laboratory work for some twenty-five years. In 1921, A. Dufour built the first high-speed cathode-ray oscillograph in which the electrons recorded directly on a photographic plate which was introduced into the vacuum. Many workers, including Rogowski, Gabor, McEachron, Knoll, Burch and Whelpton, have helped to bring this instrument to its present state, and since 1925 it has been used extensively. Direct photography, however, has now been generally superseded by the sealed-off cathode-ray tube with thermionic cathode.

After the discovery by Wehnelt in 1905 of thermionic cathodes, attempts were made to use them in high-vacuum cathode-ray tubes, these were unsuccessful until 1926, when Burch explained the action of the concentrating coil as an electron lens. These theoretical results were exploited by V. K. Zworykin, who in 1929 combined for the first time the two essential elements of the modern cathode-ray tube: a small thermionic cathode and an electron optical-lens system.

The simple electrode arrangement is now seldom found in practice, but illustrates the basic principles of electrostatic focusing.

These "soft" (gas-filled) tubes generally required a heater supply of 2-4 volts, anode potential of 500-1,000 volts and a negative shield bias of 5-50 volts. Control of the grid potential was the primary means of focusing the spot, which, when correctly focused, was 0-5-1-0 mm. in diameter.

If a potential is applied across the X plates, depending upon the sign of the applied voltage, the cathode ray will be repelled by one X plate and attracted by the other. Plate X_l is positive and plate X, is negative, the electron beam is deflected towards X_t. The movement of the ray at these plates will be apparent as a movement of the fluorescent spot on the screen, the degree of movement on the screen being enlarged in proportion to the length of the ray. If now the connections to X, and X_2 are reversed, the spot will move across to the opposite side of the screen. When an alternating voltage is applied to the X plates, therefore, the spot will clearly move from side to side in step with the frequency of the alternations.

Because of the afterglow in the fluorescent screen and the rapidity of the movement, the effect to the eye will be a steady line across the screen. The length of the line will be directly proportional to the voltage applied to the deflecting plates.

Suppose that while this line is being traced out on the screen a DC. potential is applied to the Y plates. It is obvious that the spot must tend to respond to the force thus exerted on the ray as it passes between the Y plates. This response will take the form of shifting the line bodily up or down on the screen, depending on whether Y, is positive or negative. But what will happen if instead of DC. on the Y plates an alternating voltage is applied ? It is assumed for the moment that both the X and Y voltages are derived from the power mains and are therefore both sinusoidal and of the same frequency and phase.

Two forces are now acting on the ray at the same time, and its movement will be proportional to the resultant of those forces at any instant. The line on the screen will, therefore, assume a new position, making an angle with the horizontal which is governed by the relative value of the deflecting forces. If the alternating voltages applied to the X and Y plates are equal, the angle of the line on the screen will be 45°. By variation of the relative values of the voltages applied to the X and Y plates the angle will correspondingly become greater or less.

The straight line on the screen is preserved only while the two applied voltages are of the same phase. Where there is a phase difference, the resultant of the forces acting on the ray differs from instant to instant, with the result that the spot traces out an elliptical path ranging from the straight line already discussed when the phase angle is 0° to a circle when the phase angle is 90° (and the alternating voltages are equal).

2. Найдите в тексте и переведите производные следующих слов: to investigate, to contribute, to alter, to respond, to vary, to correspond, to differ.

3. Расскажите историю создания электронно-лучевой трубки.

4. Переведите текст, начиная со слов “If a potential is applied across the X plates…”

5. Составьте аннотацию к тексту, используя следующие речевые модели:
The title of the article is …
The article consists of … parts.
The subject of the article is …
The article gives a detailed analysis of …
Special attention is given to …
The following conclusions can be drawn …

Unit 7
Anode power supply

1. Прочтите текст, найдите и переведите предложения, в которых содержатся ответы на вопросы.
a) What is the function of high-voltage rectifier and the motor-generator?
b) What are the maximum peak values of ripple voltage?
c) How are low-and medium – power transmitters fed?
d) What facilities provide the smoothest method of regulating the primary voltage?
e) What are the main types of rectifier?

ANODE POWER SUPPLY

The chief means of converting low-voltage A.C. to high-voltage D.C. for the supply of anode power are the high-voltage rectifier and the motor-generator. The development of high-voltage hot-cathode and cold-cathode mercury-arc bulbs has led to a general preference for static rectifiers. They are silent in operation, highly efficient, low in cost compared with rotary machines and the absence of moving parts simplifies maintenance.

Anode power demands vary from less than 1 ampere at a few hundred volts for low-power transmitters to as much as 20 amperes at 15 kV for high-power work. These diverse requirements are met by the use of three main types of rectifier :

(1) Metal rectifiers for low-power transmitters.

(2) Hot-cathode mercury-vapour rectifiers for low and medium power.

(3) Cold-cathode mercury-arc rectifiers for high power.

In radio technique the ripple voltage present in the rectified output must be reduced to a negligibly low value by the addition of smoothing filters, in order to prevent modulation of signals. Polyphase rectification greatly reduces the residual ripple voltage and makes it possible to economize in filter components. In practice three-phase, full-wave rectifiers are employed as far as possible. The degree of ripple voltage permissible in the D.C. output from a filter depends on the class of transmission. Maximum peak values of ripple voltage, expressed as a percentage of the D.C. voltage, which are commonly used as a basis of design are:

Telegraphy Commercial telephony Broadcasting and television 0-5 per cent 0-1 per cent 0-05 per cent

It is usual with low- and medium-power transmitters for all the R.F. and A.F. amplifier stages to be fed from a common rectifier. The full voltage is applied to the final stage, and voltage-reducing resistances, incorporated in the transmitter, are connected in series with the individual anode supply leads to drop the voltage to the working values.

There are, however, certain limitations to the use of series resistance. Unless the current taken by the earlier stages is small compared with the total current, the power loss and heat dissipated in the resistance may be excessive.

Consider, for example, a final amplifier taking 2 amperes at 10 kV and a penultimate stage taking 0-6 ampere at 5 kV. The loss in a series resistance in the penultimate stage will be 5 X 0-5 = 2-5 kW or 10 per cent of the total D.C. power. If this stage operates as a Class C or Class B amplifier, the anode voltage regulation may be seriously degraded. Assuming the current to vary from 0'5 ampere to zero, the anode voltage will swing from 5 to 10 kV. In telegraph transmitters keyed by the on/off method, this usually has no objectionable effects, but in low-level modulated transmitters it will produce amplitude distortion. The remedy in such cases is to feed the modulated amplifiers from a separate rectifier. In many high-power transmitters the main rectifier serves only the final power amplifier and the low-power stages are fed by one or more auxiliary rectifiers.

Regulation of Anode Power

The facility of being able to regulate the anode voltage is useful for testing at low voltage, making initial adjustments and reducing the R.F. output of a transmitter. Induction regulators and moving-coil regulators provide the smoothest method of regulating the primary voltage. These appliances may be either hand-operated or motor-operated by push buttons from a control desk.

The principle of operation of these regulators is the same as for voltage regulators, but the range of control and the internal kVA is greater. Voltage regulators usually have a range of ±10 percent. A power regulator capable of controlling from full to quarter power would have a range of full to half voltage or 50 per cent. Induction and moving-coil regulators are rated by their internal kVA, which is calculated as follows:

Single-phase regulators (secondary current X max. boost voltage) /1,000.

Three-phase regulators 3(secondary current X max. boost voltage)/1,000.

2. Найдите в тексте синонимы к следующим словам: small, total, principle, work, transforming, decrease, apply (2), cheap, to meet the demand.

3. Разделите текст на смысловые части и озаглавьте каждую часть.

4. Найдите в каждой части ключевые предложения, выражающие основную мысль данной части или составьте такие предложения.

5. Составьте аннотацию к тексту.

Unit 8

1. Прочтите и постарайтесь понять текст.

TRANSMITTER RADIO-FREQUENCY STAGES

The power output of the carrier source is usually of the order of a few watts, and this is raised by subsequent radio frequency amplifiers in the transmitter proper to the value required in the aerial. The valves used in the carrier source, multipliers and dividers are generally small receiving types and, because of their low anode dissipation, no precautions are taken to secure economy in operation. In the succeeding radio-frequency stages, however, the valves are progressively larger as the power to be handled increases, and economy of operation becomes essential. Wherever possible, therefore, the valves are operated in Class C conditions, for which, under favorable conditions, 80 per cent of the power supplied to the anode from the H.T. source can be converted into useful power. The sequence of valves constituting the radio-frequency amplifier are power amplifiers and not voltage amplifiers as in the early stage of audio amplifiers; each valve has to supply the power necessary to drive grid current through the following stage.

Early radio-frequency stages commonly employ tetrodes or pentodes, but later stages, particularly where the anode power exceeds approximately 500 watts, usually consist of triodes. To avoid instability, triode radio-frequency amplifiers are neutralized (as explained later), but their efficiency, under Class C conditions, is as high as that of pentodes, and their use avoids the difficulty of cooling the screen grid experienced with high-power pentodes.

The cooling of high-power valves raises a number of problems. Small valves dissipating up to approximately 500 watts do not, in general, require artificial cooling. If the construction of the transmitter is such that the air heated by the valve can readily escape by flowing upwards, and if cold air can flow in underneath the valve, the natural vertical flow of air over the valve envelope is sufficient to cool it adequately.

Larger valves handling power up to approximately 5 bW are artificially cooled by blowing a blast of cold air over the envelopes and, to make the cooling efficient, the air comes into direct contact with the anode which is arranged to form part of the envelope, glass parts of the envelope being joined to the metal anode by an air-tight seal. As a further aid to cooling, the anode is fitted with fins to give it a large surface area.

Valves dissipating power in excess of approximately 10 kW, such as those used in the final stages of high-power transmitters, usually require water-cooling in addition to air-blast cooling: in such valves the anode is constructed in the form of a water jacket through which cold water is circulated, the inner wall of the jacket forming part of the valve envelope. The cooling water comes into electrical contact with the anode and, since the latter may have a potential of up to 10 kV, precautions are taken to minimize radio-frequency power loss and H.T. leak through the resistance of the water path between anode and earth. Both losses can be reduced to negligible proportions by purifying the water (to increase its resistance) and by arranging that the length of the water path between anode and earth is very long. The latter is achieved by using long rubber or plastic hose-pipes to lead the water to and from the water jacket, the hoses being coiled up to conserve space. "Water-cooled valves are also air-blast cooled, the air being directed against the sides of the glass envelope and in particular at the points where the filament leads pass through the glass walls. An alternative method of cooling large valves, which has many advantages over water cooling, is "vapour cooling". The heat from the heat exchanger can be used for heating the transmitter building. Vapour-cooling systems need little maintenance and have been used for a number of years with complete success.

Another tendency in broadcasting transmitter design is to dispense with water cooling and to use air-blast cooling only. This is feasible, even for a high-power transmitter, if the high-power stages employ several relatively small valves instead of a few large ones. By this means the effective cooling surface is considerably enlarged and the air-blast cooling made more efficient. For medium-frequency transmitters each large valve can be simulated by a number of small valves in parallel. Such an arrangement leads to large input and output capacitances, however, and in a high-frequency transmitter it is difficult to secure high enough anode loads for satisfactory operation. In such transmitters, therefore, the tendency is to use push—pull circuits or inverted amplifiers, both of which lead to lower input and output capacitances.

2. Ответьте на вопросы по тексту.

a) What are the advantages of triode radio-frequency amplifiers?

b) How are small valves cooled?

c) How are larger valves cooled?

d) What does water-cooling incorporate?

e) What is the advantage of vapour–cooling systems?

3. Найдите в тексте и переведите производные следующих слов: stable, art, ready, to add, pure, to maintain, to relate, to consider, to arrange.

4. Сформулируйте суть каждого из описанных в статье способов охлаждения.

5. Составьте план текста.

6. Напишите аннотацию.

Unit 9

The Aerial Circuit

1. Прочитайте текст и скажите, для какой аудитории, он, по вашему мнению, предназначен.

Aerial Circuit

Good selectivity before the frequency changer is essential for present-day broadcasting conditions, especially in Europe. A useful figure for expressing selectivity of the type required here is the image ratio, in decibels, i.e., the ratio: radio-frequency input of image frequency to radio-frequency input of signal frequency, both for standard output. If only a single tuned circuit be used, the high Q-factor necessary for good image rejection will result in some side-band cutting on long waves and to a certain extent on medium waves, at least at the low-frequency end of the band, resulting in a partial loss of the higher audio frequencies.

Probably the best and most used system for a single tuned circuit is mutual inductance coupling with a high-impedance primary, resonating below the low-frequency end of the band with the combined capacitance of the aerial, the primary self-capacitance, and added shunt capacitance where used (the latter usually on long waves only}. Whatever aerial is used (an aerial for medium and long waves may be regarded as mainly capacitative, of value approximately 30-450 pF, depending on length, with 100 pF as the average), to avoid feedback troubles the resonant frequency should be well clear of the intermediate frequency. This results in a primary inductance of about 3,000 H for medium waves. The coupling factor, a compromise mainly between gain, image ratio and tracking error requirements, is of the order of 15-20 per cent and the Q-factor about 160 at 1 Mc/s, out of the set, falling to about 100 for the " working " value in the set. The 3,000-H primary may also be used for long waves by placing it between the medium- and long-wave tuned windings on the same former, and switching a capacitance across it to lower the long-wave resonance to a suitable value. This latter depends on whether it is desired to obtain a fairly uniform performance over the whole of the band, in which case the resonance would be at about 0-8 of the lowest tuning frequency with the smallest expected aerial, or to provide maximum gain at the frequency of a particular station such as Droitwich: for this a series capacitor of about 400 pF would be used to limit the effect of aerial change, and the resonance made to occur at 200 kc/s with a 100-pF dummy aerial.

Greater uniformity of aerial gain over the medium waveband may be obtained by adding " top-capacitance " coupling to the magnetic coupling, i.e., connecting a capacitor of value about 3 pF between the aerial terminal and the grid end of the tuned winding.

The relationship between adequate image ratio, Q-factor and loss of higher audio frequencies may be theoretically considered in an approximate way as follows, calculating *Q* from image ratio as described elsewhere and in reference[10]. For an image ratio of, say, 50 db at 200 kc/s (the aerial coupling improves this to, say, 60 db in practice) the "working" *Q* would be about 60, resulting in a band-width of 200/Q = 3-4 kc/s, i.e., the response is —3 db at about 1-7 kc/s.

To avoid interference from stations operating on or near the intermediate frequency, a rejector circuit should be included. This is usually connected across the primary winding of the aerial coil, and takes the form of a capacitor of about 30 pF in series resonance with an inductor of Q-factor about 150, tuned by an iron-dust core to the intermediate frequency. In a cheap set the rejector may be omitted, but provision should be made for easy fitting of one by a dealer in areas where this type of interference prevails.

Better image rejection than is possible with a single-tuned circuit, and at the same time freedom from serious side-band cutting, can be obtained by using a band-pass input circuit. This method is little used today because of its cost (it requires extra coils and a three-gang capacitor).

2. Составьте терминологический словарь к тексту.

3. Найдите в тексте синонимы к следующим словам: important, particularly, needed, cause (1 par.),; perhaps, considered, about, problems, mostly, mistake, achieve, take place (2 par.); linking (3 par.); regarded, somewhere else (4 par.); working, inexpensive, dominates (5 par.); due to, additional (6 par.).

4. Найдите в тексте и переведите производные от следующих слов: select, change, reject, part, inductor, capacitor, require, low, uniform, perform, free, band.

5. Переведите текст, пользуясь словарем.

Unit 10

PRINTED CIRCUITS AND PRINTED COMPONENTS

The idea of "printing" the complicated wiring of radio equipment was first proposed by John Sargrove in 1947. At that time it seemed that the new process would have widespread application, but for several years only sporadic use was made of the idea. Recently, however, many cases have arisen where the printing methods are regarded as fully acceptable not only from an economic point of view but also on account of their reliability and assistance in miniaturization. With the complex circuitry of modern electronic equipment every means possible is being sought to reduce labour costs, especially those associated with wiring and maintenance.

Two major trends are evident:

(a) The use of proprietary sub-assemblies.

(б) The use of printed wiring and components.

Proprietary sub-assemblies are growing in number. A typical example of this type of component is the multiple ceramic capacitor, which enables all decoupling capacitors having a common earth and associated with one particular valve-holder to be embodied in a single unit; their use not only reduces cost but also provides a greater degree of control over "wiring-variables" often so troublesome in V.H.F. "work. Another component of this type is a complete mains-interference filter.

The use of printed circuits and printed components now appears in many pieces of equipment such as hearing aids, computer circuits, amplifier strips, television deflection coils, transceivers, guided missiles, etc., where much of the circuitry is complete, apart from the simple addition of the valves.

Advantages and Disadvantages of Printed Circuitry

Printed circuits start off with the advantage that excellent conductors (i.e., silver or copper) can be used; further, such circuits are generally printed on a base-material of very good insulating value—high-grade laminated sheet to R.C.S. 1000 Grade 1 specification being a most suitable plastics base. Reliability is, however, perhaps one of the main advantages, in so far as the many hand-made joints of conventional constructional techniques are eliminated, each a potential " dry-joint " with its attendant troubles. The chances of a human error are reduced, and less inspection is necessary.

Other advantages are : mass-production methods can easily be introduced with the minimum of complicated tooling; the accuracy of printed components is high, being of the order of 1 per cent and the Q of circuits are also satisfactory ; little screening is necessary owing to the close coupling of components, and connections, being short, ensure a high efficiency; reduction in size also encourages economy and promotes the trend towards miniaturization, so necessary in many items, such as deaf-aid equipment or in guided-missile work.

"Printing" is not without its disadvantages, for instance an advanced production unit can involve a heavy capital outlay, and it is difficult to change design at short notice.

Printed-circuit Methods

Several methods are available for "printing" circuits and components, the chief of which are:

The " Stencil " or " Masking " Technique, in which a stencil of the required outline is first prepared, by photographic reduction from a master drawing or by the use in simple cases of masking tape. The conducting material is then applied by one of a number of possible methods, e.g., by brush painting, by a dusting technique, by spraying, by chemical deposition or by cathodic sputtering in a high vacuum.

The Printing Technique, in which silver ink is printed on to a glass or ceramic base and then fired. This form gives particularly good adhesion, as required for rotary switches.

Photo - etching, in which an image of the circuit required is printed on to a copper-bonded laminate-base material (this is described in more detail later).

Die-stamping Process, in which an inlay of the correct shape is stamped out and applied to the ends of all the components and then automatically soldered in one dip operation or, alternatively, bonded to a sheet of insulating material.

1. Прочтите 1ый абзац текста и ответы на вопросы:

a) What is the advantage of printed circuits?

b) Was their development an easy process?

c) What are the two main trends in printed circuits?

d) Where are printed circuits used?

2. Прочтите 2ой абзац и выберите ключевые слова, связанные с его подзаголовком.

3. Прочтите 3^ий^ абзац и сформулируйте кратко каждый из описанных методов.
4. Составьте план текста.
5. Напишите аннотацию текста, пользуясь следующими речевыми моделями:
This article is concerned with …
It is shown that …
… are given.
It should be noted that …
The following conclusions are drawn.

Unit 11

1. Прочтите текст и определите, из какого источника он взят.

Windings Operating at a Positive Potential

When a winding operates at a positive potential with respect to the core and/or to another winding, it is possible for electrolytic action to remove copper from any bare places on the wire, such as "pin holes" in the enamel, provided something in the nature of an electrolyte exists. In other words, corrosion occurs, eventually resulting in a break in the winding. Inspection of such an open-circuited winding reveals a green spot at the point of break, so the phenomenon is often called " green-spot" corrosion. In spite of care being taken to use the purest paper obtainable, checkless paper-interleaved windings are much more troublesome in this respect than pile-wound bobbins, leading to the conclusion that the paper, when not completely dry, acts as a suitable electrolyte. Experiments have shown that wax impregnation alone is useless for preventing the moisture ingress which causes this corrosion, even in temperate zones, but that wax impregnation followed by a bitumen dip is very good, provided that the bitumen dip is carefully done, avoiding pin-holes. However, a pile-wound moulded bobbin is quite good for domestic-receiver transformers in the tropics if wax impregnated, and for home use if entirely unfinished. Textiles should be avoided as far as possible, although varnished cotton tape between the windings of an unfinished pile-wound bobbin gives very little trouble. For the wax-impregnated bobbin, paper insulation may be used between the windings; this appears not to be at all as troublesome as the paper between all the layers of a paper-interleaved winding, perhaps because in the latter there are many possible paths for leakage *along* the paper to the core.

A better space-factor is obtained with pile-wound bobbins than with bobbin-less paper-interleaved construction, but the latter facilitates the achievement of good inter-winding insulation, because with it there is no tendency for the end turns of one winding to slip down to the winding beneath. If there are more than two windings, or if the windings are sectionalized to reduce leakage inductance, it may be better to employ the paper-interleaved method, using wax impregnation and a bitumen dip-coat, the latter being necessary even if the set is for use only in the temperate zone.

Examples of windings operated at positive potentials with respect to the core and/or other windings are output-transformer primaries, synchronous-vibrator transformer secondaries and smoothing chokes in positive leads. (It is not usually convenient to put a smoothing choke in a negative lead, because this prohibits the use of a common can for the electrolytic capacitors each side of the choke: electrolytic capacitors with a common positive terminal are not usually made because of trouble from leakage between cathodes.)

A recent innovation is the transformer using polyester film insulation and high-temperature synthetic enamel wire covering. Impregnation is not necessary and the operating temperature can be made much higher than the maximum permissible with older materials, resulting in smaller power transformers.

2. Озаглавьте каждый абзац текста.

3. Найдите в тексте и переведите производные следующих слов: inspect, circuit, obtain, leaf, trouble, conclude, complete, use, moist, finish, achieve, section, permit.

4. Переведите 2ой абзац текста.

5. Сократите каждый абзац до 1-2 предложений, сохранив его основную идею.

6. Составьте аннотацию к тексту.

Unit 12

Communication Equipment

1. Прочтите статью и ответьте на вопросы.

a) How is communication with aircraft carried out?

b) What are the main advantages of V.H.F.?

c) What is the reason of rapid disappearance of the use of telegraphy?

d) What is the range of transmitter power on V.H.F.?

COMMUNICATION EQUIPMENT

Communication with aircraft is carried out by amplitude-modulated telephony on very high frequencies (V.H.F,) between 118 and 132 Mc/s, and by telephony and telegraphy on high-frequencies (H.F.) between approximately 2 and 20 Mc/s. Arising from the desire to economize in the number of crew carried, the use of telegraphy—with its need for a special operator—is rapidly disappearing, and eventually only telephony may be used for both long- and short-distance communication.

Telephony sets are designed for pilot operation, and their controls are consequently as simple as possible. V.H.F. sets are crystal-controlled, either by a number of crystals cut for particular channel frequencies or by crystal-saving circuits which enable the equipment to be set to any one of the channels covering the range 118-132 Mc/s in steps of 200 or 100 kc/s (eventually these steps will probably be reduced to 50 kc/s). Channel selection is by push-button or rotary switch. The automatic-gain-control requirements for V.H.F. are stringent: without any manual adjustment during operation the equipment must work at distances from the ground station between 100 or so miles and a few hundred yards without over-loading or excessive change in volume. Transmitter power on V.H.F. ranges from a fraction of a watt on light-plane equipments to several watts on main-line aircraft. American equipments use powers up to 30 or more watts, but this is often the cause of long-range interference, and negatives one of the main advantages of V.H.F., whose limited range—compared with high frequency— enables the better segregation of local traffic. V.H.F. communications signals are vertically polarized.

V.H.F. is employed for communication with aircraft control and airfield control authorities when the aircraft is flying in areas of high traffic density under the control of such authorities. For general and long-distance communication, high frequency is used, and the equipments employed may either be pilot or radio-operator controlled. In the case of pilot-controlled equipments these are again preset to the channel frequencies required for the route to be flown, and channels are selected by push button or switch. In the case of operator-controlled equipments, these are usually crystal-controlled transmitters and continuously tunable receivers. An aircraft flying from, say, London to Singapore may require to operate on as many as 50 high-frequency channels during the journey, and this presents quite a problem in the design of an equipment of the pre-set type. Transmitter powers for long-range high-frequency telephony range up to 150 watts.

2. Найдите в тексте и переведите производные от следующих слов: to appear, to adjust, load, set, tune, to receive, to approximate, to require.

3. Переведите последний абзац текста.

4. Определите источник, из которого взят текст.
5. Составьте аннотацию к тексту.

Unit 13

COMMUNICATION TRANSMITTERS

Although basically the same in principle, modern radio transmitters differ greatly in detail from those of a generation ago. Apart from improvements in size factor and durability under extreme climatic conditions, the changes are mostly related to the vastly increased number of applications and the consequent congestion of all frequency bands, with the resulting development of measures to avoid mutual interference between services. The increasing complexity of equipment has necessitated special attention towards convenience of operation and maintenance.

The advent of transistors has made possible a spectacular reduction in size and power consumption of small portable transmitters, and despite their present-day limitations in frequency response and ambient temperature range they make useful economies possible in the auxiliary circuits of larger equipments.

The International Radio Regulations resulting from the Geneva conference of 1959 set down limits of carrier-frequency tolerance for all classes of user and additional limits are set by the British Post Office for equipment under their jurisdiction; these make mandatory for some classes the standards for sideband spread, harmonic radiation and the like, which are generally accepted as good practice in modern equipment.

Communications transmitters, although varying in size from many kilowatts down to units driven from dry batteries, have, nevertheless, many common features, which are at variance with the technique of broadcast-transmitter design. Sound quality on telephony is, of course, far less important, a frequency response covering the main speech range of 250-3,000 c/9 being adequate for most purposes. The frequency response is often deliberately distorted, in fact, the higher speech frequencies being accentuated in the interests of maximum clarity. Harmonic distortion of 10 per cent or even more at 90 per cent modulation is relatively unimportant, and for equipment working off normal mains-supply frequency a hum level of 30 db below maximum modulation is adequate. A satisfactory service may in fact be achieved with an aerial power sufficient only to give 10-db signal-to-noise ratio for 30 per cent modulation at the associated receiver.

Microphones are generally of types designed for close working to cater for conditions of high background noise, and carbon microphones of the telephone type are still in frequent use. Frequency modulation is becoming popular, particularly for the smaller portable equipment operating on the V.H.F. bands.

Aerials vary from a simple receiving-type wire or whip at one extreme to complex directional arrays at the other, but are rarely such a dominant feature of the installation as with broadcast equipment.

Telegraphy, whether by continuous-wave, modulated-continuous-wave or frequency-shift methods, is in frequent use, and sets a series of problems unmatched by any corresponding ones in the broadcast sphere.

BASIC TRANSMITTER DESIGN

The special requirements of various forms of communications service are best considered in relation to the basic sections of a primitive transmitter. These consist fundamentally of a frequency generator, power amplifier and modulator, together with arrangements for coupling the oscillator to the power amplifier and the power amplifier to the aerial, and means of interrupting the carrier wave for keying purposes.

Single-valve oscillator circuit depicts a tuned-grid circuit, in which resistor Rl serves to bias back the valve to the operating part of its characteristic at the onset of oscillation, by virtue of the flow of grid current; this will result in a Class C condition of operation, in common with other oscillators not limited by automatic-gain-control. This circuit suffers from the defect that variations in valve input capacitance, which are most marked during the valve warming-up period, have a direct influence on the frequency of oscillation, particularly at the high-frequency end of the band.

Matters are improved by reversing the positions of tuned and tickler windings, since valve-anode capacitance, in general, suffers far less variation. Further improvement is obtained by stabilizing H.T. voltage, e.g., with a gas discharge tube. The tuned circuit itself is rendered less dependent upon temperature variations by the use of low-expansion materials. The coil may be wound with stressed or fired-on silver windings on a ceramic former, or with silver-plated invar wire, whilst a variable capacitor of substantially zero temperature coefficient (5-10 parts per million per °C, compared with 60-80 parts per °C for normal types) can be achieved by the judicious use of nickel in the construction.

Recently capacitors with compensating sections controlled by bimetal elements have appeared on the market, enabling a zero or a slightly negative temperature coefficient to be achieved, and facilitating compensation for residual variations in other components.

Communication Transmitters

1. Просмотрите текст, найдите в нем и переведите предложения, содержащие ответ на вопрос:

a) What are the differences between modern radio transmitters and transmitters of the previous generation?

b) What did the advent of transistors result in?

c) What does a primitive transmitter consist of?

d) In what sphere is frequency modulation becoming popular?

e) What are the recent achievements in the field of capacitors?

2. Просмотрите 2ой абзац и выберите ключевые слова, связанные с его подзаголовком “Basic transmitter design”.

3. Составьте план текста.

4. Напишите аннотацию текста, пользуясь следующими речевыми моделями: This article is concerned with …

It is pointed out that …

The article is divided into … parts.

The main idea of the first part is …

Special attention is paid to …

… is given in short.

The following conclusions can be drawn.

Unit 14

1. Просмотрите статью и переведите заголовок на русский язык.

Meteor Burst and "Moon Bounce" Communication Systems

An interesting development in the field of communications transmission is the use of reflection from meteor trails, investigated recently by the Canadian Defense Research Board.3'4 The highly ionized trail left by a meteor entering the earth's upper atmosphere persists for a period amounting, in many cases, to several seconds. This trail can be used for two-way communication by the use of specially oriented transmitting and receiving aerials. Communication is intermittent, but the effect is so marked, even with meteors too small to be visible, and the number of such meteors is so vast, that practical use can be made of it with special equipment.

The intelligence to be transmitted is recorded on magnetic tape at normal speeds, stored as long as necessary and then transmitted in intermittent high-speed bursts. The mechanism is triggered off by the reception from the distant position of a monitor signal on a slightly different frequency, indicating the temporary existence of a transmission path. Use of a transmission rate of 600 words per minute, which is feasible with special high-speed low-inertia tape equipment at both ends of the link enables a mean rate of 60 words per minute to be maintained. Transmission speeds as high as 4,800 w.p.m. have been used over an 800-mile path.

A carrier power of 100 watts at approximately 50 Me/s has been successfully used over a distance of 600 miles, using five-element Yagi arrays. The system has a very high degree of privacy, and is immune from the normal ionospheric disturbances. Unlike the conventional "forward scatter" systems, for which much higher powers are used, it is unlikely to cause interference with other services.

“Moon bounce "communication has recently been achieved at 200 Mc/s between sites on the earth's surface several thousands of miles apart. The extreme signal attenuation due to the great length of transmission path was overcome by the use of highly directional aerial systems.

There are distinct advantages in the absence of fading and the constancy of signals received at various points of the earth's surface, despite the complexity of equipment and the need for the moon to be above the horizon at both transmitting and receiving sites.

Useful signal-to-noise ratios have been obtained with transmitter powers of the order of 5 kW and parabolic dish aerial diameters of under 50ft. Unfortunately scattering produced by the uneven surface of the moon limits the usable band-width to a few kc/s.

GROUND-TO-AIR TRANSMISSION

The ground counterparts of medium-frequency, high-frequency and V.H.F. airborne transmitters generally follow conventional lines, being usually mounted together in standard racks on a site at some distance from the Control Tower, and where possible, remote also from the associated receivers. Carrier powers of up to 2 kW on the high-frequency band and up to 50 watts at V.H.F. are commonly used. Facilities are provided at the Control Desk for modulation of a number of channels simultaneously, and a typical remote-control unit will incorporate channel-indicator lamps to enable incoming signals from a number of receivers to be identified individually and dealt with singly or in combination.

At least one stand-by transmitter of each type is usually provided ready for instant use, particularly on the V.H.F. channels, where failure during close-range work would be a serious occurrence. For the same reason, separate single-channel remote-control units are often favoured, built into a compact assembly on the main control desk.

Amplitude-modulated telephony is predominant for short-range airport use of V.H.F., with “VOGAD” circuits incorporated in the transmitters to maintain a high average level of modulation. The ground transmitter usually employs a quartz crystal oscillating at one-eighteenth or one - twenty - seventh of the working frequency, followed by multiplier stages with preset tuning controls. Where telegraphy is required, this is of the keyed-tone constant-carrier type, necessitating automatic switching out of the transmitter "VOGAD" circuit when the remote-control unit is set to M.C.W. (A2).

With ever-increasing numbers of aircraft in service, it is general practice to restrict messages to the minimum in duration to avoid congestion; in course of time the use of still higher frequencies is inevitable for short-range work, leading to radical changes in transmitter-design technique, and perhaps widespread use of frequency modulation.

2. Прочтите текст и выделите основную мысль каждого абзаца.
3. Напишите план текста.
4. Напишите аннотацию статьи.
5. Письменно переведите текст “Ground-to-air Transmission”.

Unit 15

1. Прочтите статью и дайте наиболее полное определение радиоастрономии.

TECHNIQUES OF RADIO ASTRONOMY

In 1932 Janaky discovered that there are radio waves reaching the earth from outside it. The incoming radiation has the characteristics of random noise. Since then the contours of intensity over the sky have been plotted at different frequencies; in addition to an intense belt of emission along the Milky Way, many localized, sources have been found, one of these being the Sun. The study of these naturally produced radiations has become known as radio astronomy.

At the present time observations are confined to wavelengths which can penetrate the earth's atmosphere. The micro-waves are affected by molecular absorption and the long waves are reflected out by the ionosphere. The limits are approximately 1 cm. to 30 m.

Quite apart from the intrinsic interest of the subject, practical applications include:

(i) Information on solar-terrestrial relations, leading to increased understanding of radio-wave propagation.

(ii) Information on refraction and absorption by the ionosphere.

(iii) Knowledge of the sky noise level.

(iv) Use of radio sources for navigation independent of visibility.

The techniques of radio astronomy are aimed at particular aspects of the general problem of determining the intensity and polarization of the incoming radiation as a function of direction, frequency and time.

It is already known that:

{i) The distribution of emission over the sky consists of a background radiation, superimposed on which are numbers of discrete sources which vary in size from seconds of arc upwards. The background is not resolvable into discrete sources. It has a maximum value in the plane of the Milky Way and towards the centre of the Galaxy, and is thought to originate largely in the interstellar gas.

(ii) There is a continuous spectrum of radiation over the whole observable range of wavelengths, although the intensity decreases with wavelength. Line emission of monatomic hydrogen at 1,421 Mc/s has been observed, and there are other spectral lines (notably those of deuterium at 327 Mc/s and the hydroxyl radical OH at 1,666 Mc/s) which may be observable.

(iii) Except for the Sun and Jupiter, no intrinsic variations of intensity with time have been found for any source. There are variations due to the ionosphere, notably at frequencies near the critical frequency and also fluctuations (analogous to the "twinkling" of stars) of the intensity and direction of sources due to irregularities in the F-layer.

(iv) Again excluding the Sun and Jupiter, the radiation is in general randomly polarized

(v) The sun is a source of particular interest, since it is the most accessible star. The solar corona emits thermal radio radiation, and the variation of the shape of the radio sun with wavelength gives information about electron density and temperature in the corona.

It is a highly variable source at times when there are sunspots on the disk. The Sun is then said to be active. Circularly polarized radiation has been observed at these times.

Current lines of work in radio astronomy include:

(i) Classification and correlation of the radio emission associated with solar activity.

(ii) Surveys of the distribution of the background radiation over the sky.

(iii) Measurements of the positions, intensities and angular sizes of discrete sources.

(iv) Study of the 1,421 -Mc/s hydrogen line, involving measurement of the intensity and Doppler shift of radiation in different directions.

The basic equipment required for radio astronomy is evidently a highly directive aerial and a low-noise receiver. In addition, there are such special requirements as wide-band spectrometers at metre wavelengths, narrow-band spectrometers at 1,421 Mc/s, polarimeters, etc.

2. Найдите и переведите предложения, в которых говорится о современных направлениях развития радиоастрономии и оборудовании необходимом для этого.
3. Расскажите, почему солнце представляет особый интерес для радиоастрономии.
4. Охарактеризуйте тематику, полноту и новизну сообщенных в статье сведений.
5. Докажите, что радиоастрономия является перспективной отраслью науки.
6. Составьте аннотацию к тексту, используя речевые модели:

As a title implies the article describes …

The article consists of …

The main idea of …

Much attention is given to …

It in specially noted …

The purpose of the article is to …

The following conclusions can be drawn …

Unit 16

Satellite Communication Systems

1. Прочитайте статью, найдите и переведите предложения, в которых содержатся ответы на вопросы.

a) What is the function of the earth satellites in communication systems?

b) What are the operating frequencies of satellite communication systems?

c) What is a special form of passive satellite?

d) What does an article satellite contain?

e) What are the objectives for a commercial satellite communication system?

SATELLITE COMMUNICATIONS SYSTEMS

Man's ability to place objects into orbit around the earth has made feasible a number of systems of worldwide radio communication utilizing parts of the frequency spectrum which had previously seemed suitable only for short-range working. Possible operating frequencies extend from about 100 Mc/s, below which ionospheric losses are important, to about 15,000 Mc/s (15 Gc/s), above which atmospheric losses could be serious.

In such systems the function of the earth satellite is to act as a relay point. This can be done either by providing a reflecting surface (passive satellite) or by acting as a transponder (active satellite).

The passive satellite contains no electronic equipment; for this reason it is extremely flexible in the sense that its exact use need not be fixed at the time of launching. A naturally occurring form of passive satellite is the moon (see "Moon-bounce Communications", Section 7). Since signals have to travel to and from the satellite, and the reflecting surface will inevitably introduce losses, passive satellite systems call for high-power transmitters, high-gain aerials and low-noise receivers. A type of passive satellite used in the original Echo 1 experiments in 1960 consisted of a 100-ft. balloon of plastic film coated with aluminium, providing a maximum reflectivity of the order of 98 per cent up to 20 Gc/s, until gas leakage caused the surface to become wrinkled. More rigid versions have been developed using a plastic film between two layers of aluminium.

A special form of passive satellite consists of a belt of microwave resonant dipoles in orbit. Another proposed system would depend upon an artificial ionosphere; caesium powder would be released in the ionosphere by rockets and ionized by ultra-high-power microwave beams. It would thus serve as a reflector at other microwave frequencies. The caesium cloud, however, would require replenishment by rockets at almost hourly intervals.

An active satellite contains an aerial and a transceiver, capable of receiving a signal from the earth-based transmitter and retransmitting the information either immediately or storing it, for subsequent retransmission to the ground receiver.

The active satellite can have a path attenuation of 50-80 dB less than passive types, and so requires smaller transmitter powers, lower-gain aerial systems and less-sensitive receivers. However, its facilities are fixed; it may be put out of action by any failure in the electronics; and the equipment carried in the satellite must be powered.

The main methods of utilizing satellites for communications are:

Low-level active satellites.—The information is transmitted to the satellite when in range of a given ground station; the information is stored and retransmitted when over the distant station.

Medium- and high-level active or passive satellites.—Direct one-hop communication or (with active satellites) by multiple relay using two or more satellites; such satellites may be at an altitude of from about 1,000 to 22,300 miles.

With orbits at about 2,500—3,000 miles, some eight or nine active satellites would be required to provide continuous service along a given route. However, if the orbital height of an active satellite is increased to 22,300 miles its orbit will be co-sensed with the earth's rotation (23 hours 56 minutes) so that it remains "stationary" over a given point of the earth, permitting continuous world-wide communications with three satellites. An objection to the synchronous orbit for direct two-way telephony is the transmission delay of approximately 300 milliseconds; this would, however, be of little consequence for television or teleprinter transmissions. For this reason, two-way telephone traffic will probably be confined to satellites at up to about 12,000 miles. With low-altitude orbits, Doppler frequency shift must be allowed for.

Elliptical orbits, carefully chosen in regard to main traffic routes, can provide the larger payload for a given launching rocket.

Station-keeping satellites require the use of power to actuate gas jets or other devices for correction purposes. Satellites in random orbits are simpler, but need a greater number for a given degree of coverage.

The higher the orbit, the smaller the number of orbits per day; an exact number of orbits during a day is an operational advantage.

Objectives for a commercial satellite communications system have been stated as:

(1) 24-hour service for telephony and telegraphy between all ground stations.

(2) Global coverage in association with existing telecommunication facilities.

(3) Provision for one television channel and 1,000 telephone channels.

(4) Not more than two satellite links in tandem between any twenty or thirty ground stations.

A propagation problem with high-altitude satellites is the formation of an ion sheath around the satellite, which causes severe attentuation to radio signals. A similar problem occurs in communications with space vehicles during re-entry of the earth's atmosphere; this generates a shock wave which heats the air molecules to such high temperatures that they ionize and form a plasma sheath. Plasma attenuation drops above about 20 Gc/s.

2. Найдите в тексте и переведите производные следующих слов: to object, to reflect, to transmit, power, to cover, consequence.

3. Разделите текст на смысловые части и озаглавьте каждую из них.

4. Обобщите содержание каждой части, представив ее 1-2 предложениями.

5. Выразите свое отношение к полученной информации, укажите на актуальность темы.

6. Изложите в письменном или устном виде:

- What is the text about?
- What is described in detail?
- What is given in short?
- What are the key ideas of the article?

7. Составьте аннотацию к тексту, используя ключевые фразы.

Unit 17

1. Прочитайте текст и озаглавьте его.

2. Разделите текст на смысловые части и озаглавьте каждую часть.
3. Найдите в каждой части ключевые предложения, выражающие основную мысль данной части или составьте такие предложения.

Systems having large-channel band-widths are playing an ever-increasing part in modern communications networks. They range from the simple television link used for connecting outside broadcast cameras with broadcasting stations, to the transcontinental network capable of carrying either television- channels or many speech channels.

Permanent point-to-point links for television are important because of the limited area coverage of television broadcasting stations, and since the cost of television programmes is high, it is desirable to have simultaneous broadcasting over a national circuit. Furthermore, live programmes, particularly of sport, have a great appeal. An alternative to permanent-link stations is to have overlapping broadcast areas served by different frequencies with receivers at each station to hand on the programme. Unfortunately, a high density of broadcast coverage is seldom economically justified, and high-power stations are not usually sufficiently free from distortion to permit much handling in this way.

Many hundreds of telephone channels often have to be transmitted over a trunk route between large cities. Until recently these trunk circuits have been provided by cables. However, over routes where no cable ducts exist, it seems that a radio system can be manufactured and installed more rapidly than a cable system, and a radio system can show a great saving in raw materials such as copper and lead. Other factors, such as the lack of roads and power supplies for isolated radio stations sited on hills, can put cables at an advantage because they can carry their own supplies for repeaters.

It is the general aim that the large trunk radio networks should have transmission characteristics suitable for either television or multichannel telephony, and should conform to the standards used in coaxial cable networks. The latter handles telephony channels assembled in frequency division multiplex.

Such radio systems use frequency modulation in preference to amplitude modulation because greater linearity, better signal-to-noise and more stable transfer levels are obtainable. Amplitude linearity is most stringent for multi-channel telephony, and usually the number of telephony channels carried is less than would occupy the band-width necessary for television.

As large radio-frequency channel band-widths of the order of 16 Mc/'s are used, the largest of these systems have to operate in the micro-wave bands. Consequently, the separation between stations is limited to optical ranges, and with current practice this averages a little under 30 miles. To cover great distances a number of repeater stations are used between the terminals. There are two types of repeater station, the first is essentially a receiver and transmitter connected together at the base-band frequency (that is the television or multi-channel assembly frequency). The second amplifies and changes carrier frequency without returning to the base-band frequency. The first type is used if some channels have to be taken-up or dropped-off at the repeater station, otherwise the second type is preferred, as it introduces less distortion.

The frequency bands that are generally available for broad-band radio relays systems are: 1,700-2,300 Mc/s; 3,500-4,200 Mc/s; 5,925-8,500 Mc/s. In addition, the band 890-940 Mc/s, or part of it, is available in many countries for medium band-width systems.

Other methods of modulation and multiplexing are also in use. Time division multiplex is attractive for radio transmission, as performance is less dependent upon the circuit variations usually associated with radio equipment. As the radio-frequency band-width per speech channel is large, such systems are seldom designed to carry more than twenty-four channels, and perhaps sixty channels is an economic limit. Radio circuits that have linearity just adequate for television can be used successfully for the transmission of several high-grade music channels, or about twenty-four speech channels by the use of pulse position modulation. A great disadvantage with pulse systems is that they do not readily integrate with existing cable circuits. Many thousands of channel miles are giving good service in self-contained systems.

Pulse code modulation is particularly suitable for long-distance networks not involving cable links or under conditions when the radio stations cannot be sited to obtain good carrier-to-noise ratios. The signal-to-noise ratio in the speech circuit is substantially independent of the carrier-to-noise ratio after a certain minimum is exceeded, and is also independent of the circuit length. So far, these special advantages obtained by Pulse Code Modulation have been extensively made use of only in data transmission, and even then mostly by the modulation of a sub-carrier rather than by direct modulation of the radio carrier.

In some parts of the world, particularly in North America, where some 150,000 broad-band channel miles are in service, radio relay engineers are becoming faced with the problem of frequency-spectrum conservancy. In the next few years this is likely to cause increased interest in single-sideband modulation. Without using frequency-compression techniques, single-sideband transmission, can reduce the required frequency spectrum by at least five to one as compared to the present-day frequency modulation demands. Furthermore, there are interesting possibilities in unit construction. However, development problems are difficult because the linearity problems are severe.

Some multi-channel systems operate in the V.H.F. bands, but these bands are narrow and congested. Therefore, the number of speech circuits per radio channel is usually limited to about forty-eight, and the accepted performance is frequently lower than that obtained from microwave systems. However, the separation between stations may greatly exceed optical ranges, often by as much as two to one. Equipment can be built with much lower mechanical precision than that required for the centimetric bands. Thus the use of the V.H.F. bands is attractive when capital outlay has to be kept to a minimum, and when long hops are essential for geographical reasons.

Some very attractive low-cost radio-relay equipments have been made for use in the 450- and 900-Mo/s bands. They have many of the advantages of a true microwave system and yet are mainly designed around "lumped-circuit" techniques. A capacity of 120 speech channels is not unusual. The available frequency bands are narrow, and in many countries are not very well protected from interference.

4. Найдите в тексте предложения, раскрывающие достоинства и недостатки различных систем передачи информации.
5. Охарактеризуйте тематику, полноту и новизну сообщенных в тексте сведений.
6. Определите источник, из которого взят этот текст.
7. Составьте аннотацию к тексту, используя следующие речевые модели:

The article deals with …

It is pointed out that …

Special attention is given to …

The article is divided into … parts.

The main idea of the first part is …

The fact … is stressed.

The following conclusions can be drawn…