МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ДВНЗ «Київський електромеханічний коледж»

Іноземна мова за професійним спрямуванням

Збірник технічних текстів з іноземної мови для студентів 2-го курсу з лексичними завданнями

151 – Автоматизація та комп’ютерно-інтегровані технології
141 – Електроенергетика, електротехніка та електромеханіка

Київ

2018

Transport system of Europe
(Транспортная система Европы)

Перекладіть текст. Складіть план тексту. Підготуйте переказ. Випишіть всі невідомі слова у словник та вивчіть їх. Розкажіть про транспортну систему України (12-15 речень).

It is known that Great Britain is a member of European Community and contributes much to its development. The transport sector makes a vital contribution to the European Community’s frontier-free single market. Without efficient transport networks, two of the European Community's basic principles — the free movement of goods and of people — would not function. In preparation for the single market, the. Community has adopted a series of laws liberalizing the main modes of transport: road, rail, air, sea and inland waterway.

More progress has been made in creating an integrated EC transport policy in the past fifteen years than in the previous 40. Community legislation now exists for all modes of transport, creating new open-market conditions. The benefits for Community companies and citizens have been immediate. The Community supports major projects like the EC's high-speed train system, the Channel tunnel, the modernization of Europe's air-traffic control. But more remains to be done both in terms of abolishing residual national restrictions and of integrating national networks across Europe. These need to be re-drawn and up-graded to single trans-European networks. Other priorities for action concern congestion, safety and environmental problems, the unequal utilization of different modes of transport and transport links to the EC's neighbours in the EFTA countries as well as in Central and Eastern Europe.

In response to these challenges, the European Commission has defined a global approach to achieve what it calls sustainable mobility.

Duties of railwaymen
(Обов’язки залізничників)

Перекладіть текст. Складіть план тексту. Підготуйте переказ. Випишіть всі невідомі слова у словник та вивчіть їх.

[The normal working week of railwaymen is now 40 h in many countries; however, there are still countries where working hours are 48 a week or more. Shift work is widely practiced in the railways, which must operate without interruption, and the proportion of shift workers is as high as 55% in Japan and 47% in Hungary. In several countries the number of hours per 24 h of work done completely or partially at night is more or less strictly limited.]

Train crew. The key figure on the railways is the locomotive or engine driver. As indicated above, however, the profound changes inherent in the switch from steam to electric or diesel motive power may cause difficulties of adjustment and adaptation, particularly for older men.

Before beginning his journey the locomotive driver must check that his locomotive is in good running order and if necessary carry out appropriate maintenance work. During the run he has to watch for signals, observe speed-limits and brake or accelerate accordingly. Because the rails and the wheel flanges guide the wheels of the locomotive, steering as such is not required; however, the driver has to watch a large number of control instruments and indicator dials and gauges, and on steam trains also carry out a certain amount of physical work in adverse conditions.

The fireman on a steam locomotive has to do heavy or very heavy physical work-a shovelful of coal weighs up to 1 5 kg, and about 20 t of coal are needed to move a heavy goods train a distance of 1 000 km. Other members of the train crew include the guard, the dining-car staff on long-distance passenger trains, carriage-cleaning staff (who nowadays often travel on the train and work during the journey) and, on luxury trains, secretarial staff for businessmen and executives.

Service staff. Dispatchers, supervisors, signallers and pointsmen share the operating responsibility with the train crews but work regular shifts. In busy stations and signal-boxes the responsibility is very great, and at peak hours the work is done against time. Here the main demands are for concentration, clear-headedness and precision; muscular strength is of lesser importance. In former days shunters used to perform some of the roughest and most tiring manual work, mostly at night *and* in all weathers.

Level-crossing keepers have the responsibility of closing crossing-gates in good time (but not too soon). In country districts and where traffic is light this work *may* confidently be entrusted even to a handicapped person, if reliable; however, denser traffic (both road and - rail), higher speeds and the resulting longer braking distances impose fairly stiff requirements.

Permanent way staff. Track maintenance work has much in common with subterranean construction. Regular maintenance operations include packing sleepers (formerly a manual operation carried out with packers and pick, and now effected mechanically), testing fishplates, greasing and (in winter) de-icing points, etc. As mechanization progresses, the ganger and platelayer are being relieved of the heaviest work but its undesirable features have been replaced by others.

Technical and workshop personnel. In railway sheds the locomotives and rolling stock are overhauled and serviced; the work includes routine cleaning with dilute lyes or acids, and minor repairs. The prescribed examinations are carried out at regular intervals in the repair shops, where any extensive repairs are also undertaken. This involves metalwork, woodwork, welding and large-scale painting. These shops are not run on mass-production lines, nor is there an assembly line, as is the case in locomotive and wagon manufacturing works; the dismantling of vehicles and the great variety of jobs to be tackled mean that the risk of accidents and the amount of dirty work to be done are both considerably higher than in the construction sheds.

Railroad Development: 1850-1900.
(Розвиток залізниці: 1850-1900.)

Перекладіть текст. Складіть план тексту. Підготуйте переказ. Випишіть всі невідомі слова у словник та вивчіть їх.

The second half of die 19th century saw the railroad reach maturity and become a world-wide technical, economic, and social phenomenon. In the earlier part of the half century, railroad accidents became frequent and serious, as locomotive and car sizes grew rapidly, overstraining tracks and bridges. The first steel rails were introduced in England in 1857, and the first steel bridge was built, over the Mississippi at St.Louis, in 1867-73. Other major technological advances included automatic electric block signalling, telegraphic train dispatching, automatic coupling, and air brakes. Railroads learned to work together on common standards for brakes, couplers, and wheels, to permit interchange of equipment among different lines.

As the country where the railroad originated, Great Britain was the first to experience intensive building. Construction of new lines peaked there during the 1840s, when some 4,500 route miles (7,200 km) were laid down, and remained at a high rate during the next two decades. By 1870 Britain had about 13,500 miles of railroad, largely double tracked. In the remaining three decades of the century the pace slowed down, but other important developments took place. Physical plant of the main lines was improved. In Scotland bridges were built over two great firths of Tay and Forth. The first built over the Tay, on wrought-iron piers, was blown down in a gale (1879) and was replaced in steel. The Forth was bridged by the world's longest span bridge, a giant cantilever (1890). The first world's longest underwater tunnel was driven under the Severn for the Great

Western Railway (1886). First-class sleeping cars were introduced on trains between London and Scotland in 1873, and dining cars on the Great Northern's London to Leeds line in 1879. On August 22,1895 competing trains of two lines raced from London to Aberdeen, Scotland, both completing the ran at average speeds in excess of 60 miles (100 km) per hour.

Meanwhile, countries in other parts of Europe and throughout the world were getting their first railroads or expanding their small beginning networks to national proportions.

Railways
(Залізниці)

Перекладіть текст. Складіть план тексту. Підготуйте переказ. Випишіть всі невідомі слова у словник та вивчіть їх.

In recent years the development of road traffic and the construction of pipelines have adversely affected rail traffic in many countries, although there is reason to believe that in the densely populated industrial regions of the world rail traffic may well, in time, regain its former importance. However, railways still play an important role in the national economy.

The economic importance of railways is measured in passenger-kilometres or tonne-kilometres per head of population (see table 1). Passenger transport is one of the most important functions of the railways. Goods transport is divided into two categories-piece goods (express freight) and bulk goods (including animals) in complete wagon loads. Other services offered include special types of wagon for specific goods, and containers for door-to-door traffic. The use of containers, although having certain social repercussions, does make combined sea/rail transport possible without there being any need to handle the actual cargo at the docks. In both passenger and goods transport the trend is towards higher speeds.

Effects of modernization
(Ефект від модернізації)

Перекладіть текст. Складіть план тексту. Підготуйте переказ. Випишіть всі невідомі слова у словник та вивчіть їх.

Technical progress and increasing automation are profoundly modifying the traditional duties of the railwayman. It is in the field of motive power that the most striking changes may be seen, electric and diesel units have replaced steam locomotives in industrialised countries, and in many modern locomotives a fireman is no longer needed as they may be driven and controlled by one man alone Station and signalling operations are being rationalised and similarly call for smaller staffs Large signal-boxes with electronic equipment and closed-circuit television, combined with complex dispatch centres, can now cover stretches of track which formerly required ten or twenty small signal-boxes.

[High-speed trains have required a review of the safety arrangements for men working on the track, to give them adequate warning of the approach of a train and provide them with safe refuges. The distances at which trains .must be seen to provide the necessary warning period are as follows:

In the maintenance of tolling stock, too, fewer men are needed. A modern electric locomotive requires less maintenance work than a steam locomotive it runs for longer periods without attention, and operations such as cleaning have been partly automated.

Unlike other transport undertakings, the railways themselves have to keep their tracks in good repair The rails, permanent way and signalling system must all be kept under constant surveillance; however, the very heavy manual work by platelayers that track renewal used to involve may now be carried out by machines, so that nearly a kilometre of prefabricated track (ready-made lengths of track with rails and sleepers already fastened together) can be laid in a single workshift The use of continuous welded rails marks a great advance in this respect.

Shunting operations are also undergoing changes in a humped marshalling yard the individual wagons may be electronically classified according to their destination, weight, special loading requirements, etc. and then automatically guided to their correct place on the correct marshalling track. Coupling and uncoupling are still carried out manually and remain hazardous operations, but in the future automatic coupling is expected to be generally adopted (see below).

Modern Problems Facing Railroads
(Сучасні проблеми залізниці)

1. Прочитайте текст та перекладіть англійською мовою.

2. Поставте 15 питань до всього тексту англійською мовою (General and Special Questions).

3. Якою є Ваша думка стосовно місця залізниць на сучасному ринку перевезень? Відповідь подайте англійською мовою.

4. Перепишіть речення. Підкресліть модальні дієслова. Перекладіть речення українською мовою.

The railroad industry can look back over a proud history. Railroads were a vital element in the Industrial Revolution. They helped make Britain an industrial power, played similar roles in countries such as France and Germany, and went on to do much the same in Russia and Japan. Railroads almost literally built the United States and Canada; and they remained the economic backbone of most of the major world powers.

But as the last third of the 20th century began, the railroads in a number of countries, most notable Britain and the United States, were in serious trouble. The railroad's share of the total transportation business was dropping steadily. The railroads in most countries had long since come under state control, and the remaining privately owned lines were finding it difficult to operate at a profit. Some observers believed the end of railroading was in sight. Technology was evolving so rapidly that it was impossible to say, as of the early 1970s, that this could not happen, but it seemed unlikely. It was becoming clear, however, that the railroad of the future would have a different role to play than in the past.

For more than a century the railroad was the dominant form of land transportation in much of the world. It was, and remains, the one land carrier that can carry almost anything, anywhere the tracks go, and do it at a true cost lower than other types of land-air transportation.

Today, however, other modes of transportation have been developed to the point where they can do certain transportation jobs more effectively than the railroads. Pipelines can carry liquids and some solids over long distances economically. Airplanes, with their great speed, can carry some types of light, valuable freight at a saving; and trucks offer speed and flexibility, especially for the shorter hauls. The private automobile, operating over modem highways, and the airplane have taken over much passenger traffic formerly handled on rails. The motorbus is an effective competitor for the short- to medium-distance passenger business. The modem barge,, operating on improved inland waterways systems, can move many commodities over specific routes at very low cost.

Undeniably, these competitors of the railroad can do a better job on some types of transportation tasks. The development of these newer modes, therefore, has changed the role of the railroad from that of the general-purpose carrier to that of a more specialized carrier, just as other modes are specialized.

Future Role of Railroad
(Майбутня роль залізниці)

1. Прочитайте текст та перекладіть українською мовою.
2. Випишіть всі невідомі слова у словник та вивчіть їх.

The future role of the railroad as a specialized carrier will vary in different nations. In general, however, the railroad is particularly strong in a number of areas.

First of all, it is especially effective in moving large volumes of bulk commodities, such as coal, ores, chemicals, and grain, over relatively long distances. It can also move large volumes of finished merchandise economically at relatively high speeds over long distances. The railroad can effectively handle containers in large volumes between major centers, and in some countries, trucks on «piggyback» trains. AN efficient railroad container or piggyback shuttle system can be viable even over relatively short distances. The railroad is the best mode for moving large numbers of commuters between big metropolitan centers and the outlying suburban areas. Very high-speed intercity passenger services can be successful when operated with modern equipment at distances of up to about 300 miles.

In short, the railroad under modern conditions is at its best as a high-volume, medium - and long-distance carrier of both passengers and freight. There are, of course, many exceptions to this general rule.

In looking at the future place of railroads, three other factors should be noted, too. A railroad disturbs the natural environment far less than a highway or an air-transport system. It also produces less pollutants per unit of transportation performed than either highway or air transportation. These factors should become more significant as society increasingly concerns itself with the need to preserve the environment and to reduce air, water, and noise pollution.

A railroad is far more efficient in its use of fuel than either highway or air transportation is. It is probable that future concern over the best use of these resources will produce more emphasis on rail transportation. While much public money has gone into technological research of the newer forms of transportation and into constructing facilities for them, relatively little has been spent to improve railroad technology. Thus, even the most advanced of today's railroad plants and services, with few exceptions, do not represent anything like the best that is possible from the railroad. As an example, experiments arc going on working out tracked passenger vehicles which can go much faster than conventional trains.

First Railroads in the USA.
(Перші залізниці у США)

1. Прочитайте текст та перекладіть українською мовою.
2. Складіть план тексту. Підготуйте переказ.

Interest in railroads in the United States developed almost as soon as in England. One of several horse-drawn tramways built early in the 19^{th} century was Gridley Bryant's Granite railway in Quince, Massachusetts. This three-mile broad-gauge line carried the granite used in building the Bunker Hill Monument in Boston.

By 1813 the inventor Oliver Evans was proposing a railroad between New York and Philadelphia. Two years later, John Stevens received from the New Jersey legislature the first charter for an. railroad ever granted in America. Stevens was ahead of his time: the chartered line, between the Delaware and Raritan rivers, was never built.

But in 1825 he built and operated the first locomotive to run on rails in America; it ran on a half-mile circle of track at Steven's home in Hoboken, New Jersey.

Success of the Stockton and Darlington in England spurred interest in railroads in the Unites States. On February 28, 1827, the Baltimore and Ohio Railroad Company was chartered. The line began carrying revenue traffic on January 7, 1830. The first 13 miles of line, from Baltimore to Ellicott's Mills opened on May 24, 1830.

The Baltimore and Ohio was the first railroad in the United States to be chartered as a common carrier of freight and passengers. * Its promoters, looking beyond local needs, envisaged a line going all the way to the Ohio River to channel the commerce of the growing Middle West through the port of Baltimore. By 1834 the Baltimore and Ohio had built to Harpers Ferry, Virginia, and on December 24,1852, it reached the Ohio River at Wheeling. Subsequently, the company expanded, both by new construction and by acquiring other railroads, until it reached Chicago, St. Louis, and the Great Lakes.

With few exceptions, early railroads were designed to promote the commercial interests of local communities or areas. As growth progressed, however, many of the small roads were consolidated, forming through routes that served fairly large territories, and new railroad projects became more ambitious. The Pennsylvania Railroad Company (now Penn Central) completed its line from Philadelphia to Pittsburgh in December 1852, using ten inclined planes to climb over the Allegheny Mountains. A little more than a year later, it completed an all-rail route.

Ukrainian railways unite countries and continents!
(Українські залізниці єднають країни та континенти!)

1. Прочитайте текст та перекладіть українською мовою.
2. Випишіть всі невідомі слова у словник та вивчіть їх.

Geographical position has determined key geopolitical role of Ukrainian transport infrastructure in external trade between rapidly developing markets of Europe and Asia.

Ukrainian Railways cooperate with the railways of Russia, Belarus, Moldova, Poland, Romania, Slovakia and Hungary.

Main transit flow through the territory of Ukraine goes in the direction of sea ports and on land crossings from East to West and in reverse direction. General extension of Ukrainian railways net is 22,1 thousand km, including 3,2 thousand km of international transport corridors. More than 60% of cargo is transported via international corridors.

In order to attract transit flows, to speed up and simplify customs procedures for transit freight Ukrainian railways use new regulations since 2004. SMGS or CIM consignment note is used instead of freight customs declaration.

In June 2003 the Parliament of Ukraine approved the Law according to which Ukraine joined KOTIF transport regulations with European gauge lines:

Khalmey-Djakovo—Batjevo—Chop/Chierna-nad-Tisoy (Chop/Zakhon), Batjevo—Mukachevo, Medyka/Mostiska II— Mostiska I, Dorohusk/Yagodun—Kovel. It appears to be a big progress in the integration process of Ukraine to European transport system.

Ukrzaliznytsia participates in international railways organizations and plays active role in formation of competitive tariff and transportation conditions for international freight. Such position increases its image and ability to influence the mentioned processes.

During XIII Tariff Conference (October 25-27, 2004 in Dushanbe) Ukrzaliznitsya was appointed a Chief for Tariff policy in CIS railway administrations.

Ukrainian railways and ports potential allow transporting up to 100 mln ton of transit freight.
The territory of Ukraine appears to be most satisfactory for your transit freight due to high-class transport service and profitable tariffs.

OHM'S LAW
(Закон Ома)

1. Прочитайте текст та перекладіть українською мовою.

This is the well known and fundamental law in electricity which makes it possible to determine the current flowing through a circuit when the resistance in the circuit and the potential difference applied to it are known. What Ohm discovered was that the ratio of the potential difference between the ends of a metallic conductor and the current flowing through the metallic conductor is a constant. The proportionality constant is the electrical resistance.

Resistance = potential difference/ current

Symbolically, Ohm's law is often written

R= U/ I, or 1 ohm = 1volt/1 ampere.

Using Ohm's law is of great importance because of its being generally applied to so many electrical phenomena. One of its simplest applications is using a dry cell directly connected by wires to a small light bulb. The battery maintains a potential difference of 1.5 volts across the lamp. The electron current flowing through the circuit being 0.5 ampere, the resistance of the circuit is

R=1.5volts/0.5 amp.=3 ohms.

Although the resistance as found here is assumed to be the resistance of the light bulb, it really includes the resistance of the connecting wires, as well as the resistance of the battery. In practice one usually uses wires of sufficiently low resistance that they can be neglected in most calculations. If they are not small, they cannot be neglected and must be added in as part of the R in Ohm's law.

Although electromotive force and potential difference are both measured in volts there is a real distinction between them. Electromotive force is defined as the work per unit charge done by the battery or generator on the charges in moving them around the circuit. Potential difference between two points is defined as the work per unit charge done by the charges in moving from one point Io the other.

If any two of the three quantities: resistance, current and potential difference are known for a circuit, the third can always be determined by substituting in Ohm's law. In other words, any one of I lie three factors may be the unknown, and Ohm's law may be written in any one of three ways:

I=U/R, R=U/I, U=IR

2. Перекладіть на англійську:

Закон Ома для повного кола

Усяке повне коло електричного струму складається із двох частин: зовнішньої й внутрішньої. Коли коло замкнуте, електричний струм протікає як у зовнішній, так і у внутрішній частині кола. Тому що джерело струму також має опір, зміна напруги має місце, як у зовнішній, так і у внутрішній частині кола.

DIFFERENCE BETWEEN CONDUCTORS AND INSULATORS FROM THE ELECTRON VIEWPOINT
(Різниця між провідниками та діелектриками з електронної точки зору)

1. Прочитайте текст та перекладіть українською мовою.

When a conductor is carrying an electric current, the electrons are moving gradually along through the substance of the conductor. Now in a solid body, such as a metallic conductor, the atoms or molecules comprising the substance are known practically to be fixed in position. They are not actually stationary in space at ordinary temperature, of course; as a matter of fact, the atoms have an irregular to-and fro-motion similar to that of the electrons. But there cannot be a progressive motion of the atoms as there may be of the electrons. The reason for this is more or less evident. Suppose a current to be flowing along a copper wire. The electrons move all the way around the circuit through the wire, connections, solution in the battery, etc.

The atoms of copper being charged positively after an electron has left them, it might seem that as the electrons move from B to A through the wire the atoms would move from A to B, then into and through the battery and so back to the wire. But the atoms are the real substance of the wire, and hence if the atoms should progress one way or the other it would result in the copper itself being carried from one end of the wire to the other and then through the battery. This state of affairs is not possible in solid bodies like metals, it would result in the mixing of metals wherever a current left one metal and went into another.

In chemical solutions, e. g., copper sulphate in water, the salt molecule breaks up into two parts, one of which has one electron more than its proper number, the other part lacking one electron. The two parts of the molecule are called ions; the metallic ion (in above case, copper) lacks one electron and so is charged positively. If now a current is passed through such a solution, the metallic ion does move through the solution and is carried from the solution to one of the wires by which the current is led into the solution. Here copper itself is transported by the current and we have the process of electro-plating.

From what has been said it follows that the molecules of a body clinging to the electrons so tightly that none of them are free to move away from the molecule, there can be no current in such a substance. As long as the molecule keeps all the electrons, it remains electrically neutral, and so has no tendency to move in an electric field. This is the essential difference between insulators and conductors; in one the electrons cannot move from the atom or molecule and in the other the electrons are perfectly free to leave the atom.

2. Перекладіть на англійську:

Добре відомо, що мідь і срібло чинять дуже малий опір електричному струму. Те, що вони мають таку властивість, робить їх гарними провідниками електрики. Що ж стосується гуми, то вона позбавлена цієї властивості, тому що вона, навпаки, чинить великий опір протіканню електричних зарядів. Цим обумовлюється її широке застосування для ізоляції проводів.

THE POINT-CONTACT TRANSISTOR

1. Прочитайте текст та перекладіть українською мовою.

In 1948 Bardeen and Brattain reported on work with a second point contact on a germanium diode, which showed that when the second contact was biased in the reverse direction its current could be controlled by the current through the forward-biased first rectifying contact. They called the resulting solid-state three-electrode device the transistor.

The forward-biased electrode is referred to as the emitter, the reverse-biased electrode being the collector, and the germanium or silicon element is the base. The unit uses an N-type semiconductor wafer about 0.5 mm thick, the two wire contacts being spaced about 0.05 mm (0.002 in).

The positive bias on the emitter immediately removes electrons from the valence bonds near the surface, creating holes. In fact the emitter is said to inject holes into the semiconductor, the emitter current being composed of electrons. The holes immediately diffuse toward the negative collector. In the process many holes may meet and recombine with the free electrons in the N-type base material. To reduce this loss of holes, the emitter and collector must be close-spaced. Holes that reach the collector area combine with excess electrons injected into the region by the collector, this permitting the reverse-biased collector to inject more electrons, increasing the collector current to the base.

The holes, in travelling from emitter to collector by random paths, set up a positive space charge. This space charge attracts more electrons from the collector and serves to further increase the electron flow from the collector. While some of these electrons serve to neutralize holes, the majority flow toward and reach the base terminal, forming a base-collector current.

The mobility of electrons is about twice that of holes, so that a hole is on the average able to neutralize the charge due to about two electrons, and the collector current may be expected to have a ratio of electrons to holes of about 2, with a total collector current about three times the emitter current. It may also be seen that this collector current depends on the number of holes injected at the emitter and can be controlled by the emitter current, since otherwise the current to the reverse-biased collector would be very small.

A point-contact transistor can also be made from P material. The emitter is forward-biased but negative, the collector being back-biased and positive.

2. Перекладіть на англійську:

Транзистор може виконувати функції вакуумної лампи тріода. Його перевагою перед електронною лампою є те, що він не вимагає потужності для нагрівання катода. Маючи більш низькі рівні внутрішнього опору, транзистор може працювати при більш низькій прикладеній напрузі з більш високим коефіцієнтом виходу потужності. Завдяки відсутності катода, що емітує, термін служби транзистора більший, ніж в електронної лампи. Його недоліком є усе ще низька верхня межа частоти (до декількох мегагерц), а також більш високий коефіцієнт внутрішніх шумів.

THE DYNAMIC LOUD-SPEAKER
(Динамічний гучномовець)

1. Прочитайте текст та перекладіть українською мовою.
2. Складіть план тексту. Підготуйте переказ.

A loud-speaker of conventional design is shown in cross section in the figure below. Its function is the same as that of a telephone receiver, i. e., to change audio-frequency currents from the last amplifier in a radio receiver or public address system into sound waves of the same form.

There are three main parts to every loud-speaker. First, there is a strong shell-type magnet whose function is to provide a field radially outward from a central N pole, across a narrow air gap, to a ringlike S pole. In small speakers this field is provided by an alnico permanent magnet, whereas in larger high quality units an electromagnet is employed. The second element is a small cylindrical voice coil consisting of a dozen or so turns of wire fixed *near the apex of a paper cone and centered in the narrow field gap by a springy fiber disk called a spider. The third is a step-down transformer, its low voltage, high current winding being connected by flexible wires to the voice coil.

A varying current from "output" transformer passing through the voice coil, varying forces are exerted which cause it to vibrate back and forth along its axis. As the cone is driven back and forth it acts like a plunger, its large area setting considerable air into vibration. The walls of the room or cabinet behind which the speaker is mounted is observed to act as a baffle preventing sound waves from the back surface of the cone from getting around to interfere destructively with the waves from the front surface. A good demonstration is to be) had by removing a speaker from its normal mounted position and listening to the distorted sounds it seems to produce. The low-pitched sounds in particular are noticeably absent.

It is a matter of common observation that large sized speakers with a suitably large baffle area are particularly good at reproducing and dispersing low-pitched sounds. Due to diffraction and interference, however, high-pitched sounds are emitted in a narrow beam and in a forward direction only. Speakers with small cones, on the other hand, are particularly good on the high-pitched notes but are generally poor at reproducing the "lows".

ELECTRICAL ENGINEERING
TYPES AND CHARACTERISTICS OF ALTERNATING CURRENT MOTORS
(Типи електричної розробки та характеристики двигунів змінного струму)

1. Прочитайте текст та перекладіть українською мовою.
2. Розкажіть про типи електродвигунів та їх особливості.

Only three general types of a-c motor are found in practice, a comparatively large number of different constructions being available for use in a-c systems. The reasons for this situation is that each type of a-c motor is confined to narrower operating characteristics, especially with regard to such important matters as torque, overload capacity, speed variation, speed control, and starting procedures. Furthermore, a-c motors must be constructed for operation on single-phase service or polyphase (either two- or three-phase) service; in one type of construction they must perform satisfactorily on d-c service as well as on single-phase alternating current.

Classification of Single-Phase Motors. Single-phase motors generally have low horsepower ratings and are used to operate mechanical devices and machines requiring a comparatively small amount of power. Their greatest fields of application are in the fractional-horsepower range, that is, below. 1 hp. Motors larger than the latter, up to perhaps 10 hp, are sometimes used on farms and in small shops and factories where polyphase power is not available. Polyphase motors generally have better operating characteristics than single-phase machines and cost less per horsepower, so that it is usually true that single-phase motors are used in the larger sizes only because of two- or three-phase service not being available.

In the single-phase classification may be listed the following types of motors: shaded-pole, reluctance, split-phase (with or without capacitor starting), repulsion, repulsion-start, repulsion-induction, series (a-c only or universal), and synchronous.

Shaded-pole and **reluctance motors** are built in very small sizes from about 1/500 to 1/6 hp; they are cheap to construct, have low starting torque, little overload capacity, and low efficiency and may be speed-controlled.

Standard **split-phase motors** are manufactured in sizes up to 3/4 hp; they are comparatively low in cost, have fair starting torque, not much overload capacity, and fair efficiency, and operate at nearly constant speed. Split-phase motors equipped with capacitors have high starting torque and may or may not be arranged to continue to run with a capacitor. Their capacitor being used only during the starting period, they are called capacitor-start split-phase motors; two values of capacitor being provided, one for starting and another for running, they are referred to as two-value capacitor motors. However, whether or not these motors are provided with capacitors, they are all, nevertheless, split-phase motors.

Series motors are usually constructed for service on direct or alternating current up to 60 cycles, in which case they are called **universal motors**. When properly designed, they will operate with complete satisfaction on direct or alternating current, developing high starting torque, having excellent overload capacity and good efficiency, and, permitting the speed to be controlled over very wide limits. Such motors are not as trouble-free as those described above (shaded-pole, reluctance, and split-phase types), because they have the usual commutator and brushes and their accompanying commutation problems.

Synchronous motors, as the name implies, operate at synchronous speed, that is, a definite, constant speed determined only by the frequency of the supply and the number of poles on the machine. They have very little starting torque, practically no overload capacity, and are quite inefficient; they have, however, the one important characteristic possessed by none of the motors previously discussed, that is, absolute constancy of speed, a requirement that is very important for timing devices.

Classification of Polyphase Motors. Polyphase motors, that is, machines served with two- or three-phase power, may be classified as follows: induction (squirrel-cage or wound-rotor types), commutator, or synchronous.

Squirrel-cage induction motors are widely used because of their having, generally speaking, desirable all-purpose characteristics. They are comparatively low in cost per horsepower, have good starting torque and overload capacity, are highly efficient, and are particularly rugged and trouble-free. These motors will operate in an atmosphere containing dirt, moisture, or corrosive or explosive fumes and can even be constructed to perform submerged in oil or water. They are, practically speaking, constant-speed motors in the sense that change in load does not affect the speed by more than about 5 per cent. Such motors are, however, of a disadvantage when it becomes necessary to control the speed, because it is usually difficult or expensive, from the standpoint of additional equipment, to do so. When speed control becomes a necessary requirement of an application, the squirrel-cage rotor is often replaced by a wound rotor, its winding ends being connected to slip rings. Speed control is then accomplished by connecting a resistor controller to the brushes riding on the slip rings; the greater the resistance inserted, the lower the speed, and vice versa. Wound-rotor motors, therefore, differ from squirrel-cage motors only by the construction of the rotor, the stator of both types being exactly similar. In addition to its speed-control feature, the wound-rotor induction motor also develops considerably more starting torque. It does, however, have a lower full-load efficiency and a greater speed variation with load changes than does the squirrel-cage type of motor.

Synchronous motors for polyphase service are generally constructed with a stator core and winding similar to those used on induction motors (squirrel-cage or wound-rotor), but with a rotor consisting of a set of salient poles. The latter must be excited with direct current from a small exciter, that is, a self-excited shunt generator, mounted on an extension of the motor shaft or coming from a separate d-c source. Direct current is fed to the rotor field through brushes and slip rings. Since synchronous motors, as such, have no starting torque, it is always necessary to provide the rotor poles with a complete squirrel cage built into the pole faces. The motor can then be started in much the same way as are squirrel-cage induction machines; when nearly synchronous speed is reached, the d-c rotor field is excited, after which the motor continues to run at exactly synchronous speed. The outstanding advantages of this type of motor are (1) absolutely constant speed, determined only by the frequency of the supply and the number of rotor poles, and (2) the possibility of adjusting the motor power factor to any desirable value. Synchronous motors, when properly designed, have good starting torque, overload capacity, and efficiency. They are more expensive than induction machines in the smallest sizes, but cost about as much as squirrel-cage or wound-rotor motors in ratings of more than 100 hp. As a rule, synchronous motors are used in applications requiring infrequent starting, where the load is substantially constant, and where high power factor or power-factor correction is desirable and profitable.

Although the speed of a wound-rotor motor can be changed over a wide range by the insertion of resistance in the rotor circuit, the efficiency of operation is very low at reduced speed. To offset this disadvantage, particularly in large motors where energy cost is important, special types of machines have been developed. There is a special motor construction that has wide speed-control possibilities. In this motor, the stator is of the usual construction found in induction machines, but the rotor differs greatly from any of these already described. The latter has two windings, one on the top of the other, placed in deep slots. The primary winding, in the bottom of the slots, is connected to slip rings and is fed, through brushes, with polyphase alternating current. The other winding, on top of the primary and next to the rotor surface, is connected to a commutator. Finally, the stator winding, called the secondary, is connected to brushes riding on the commutator. Speed control is accomplished by shifting the brushes over the commutator, the method used being an ingenious mechanical lever construction permitting the motion of all brushes simultaneously by the manual or motor-controlled operation of a handle. Such motors are high in cost per horsepower but have good efficiency, starting torque, and overload capacity. They are used only when it is extremely important that the speed be varied over a wide range. An additional advantage of this motor is that power-factor adjustment is also possible.

TRANSFORMERS
(Трансформатори)

1. Прочитайте текст та перекладіть українською мовою.
2. Складіть план тексту.
3. Розкажіть про трансформатори.

It is undoubtedly true that the principle of transformer action and the practical application of this principle in connection with the construction of transformers and induction-type motors are responsible for the widespread use of alternating current as a primary source of electrical energy. The transformer is a simple, efficient, and comparatively inexpensive device used primarily in a-c circuits for the purpose of changing the voltage from one value to another. There are no moving parts in the transformer, which means that mechanical losses, always present and responsible for much of the heating of rotating and reciprocating machines, are entirely absent. Actually, a transformer is a device that transfers electrical energy from one electric circuit to another without a change of frequency. This energy transfer usually takes place with a voltage change, although the latter is not always necessary or even desirable. The electric circuits being insulated from each other, as they are in most transformers, they are conventional and are generally referred to as transformers. In some special cases, the electric circuits are joined together, in which case the device is referred to as an autotransformer. The electric transformer winding being connected to the source of supply is called the primary, the winding that feeds the load being known as the secondary. Some transformers are designed to raise the primary voltage to a higher value, in which case they are known as **step-up** transformers; others are constructed to reduce the primary voltage to a lower value, in which case they are called **step-down** transformers. In step-up transformers the current on the secondary side is lowered in the same ratio as the voltage is raised, in step*down transformers the current on the secondary side being raised in the same ratio as the voltage is lowered. Transformers have- many applications in a-c circuits that require both the raising and lowering of the primary voltage as well as the lowering and raising of the primary current. When used in groups in polyphase circuits, they are especially valuable in performing many important functions, one of which, apart from its voltage-changing use, is to change the number of phases from two to three, three to two, three to six, or several other combinations.

BATTERIES
(Батареї)

1. Прочитайте текст та перекладіть українською мовою.
2. Складіть план тексту.
3. Розкажіть про батареї.

Batteries as continuous sources of electrical energy are the result of a long series of experiments which started with the discoveries of Alessandro Volta more than one hundred years ago. Today battery cells are manufactured in two common forms, dry cells being used in flash-lights, portable radios, etc., wet cells being used in .automobiles, airplanes, boats, etc.

We know each cell of every battery to have two terminals: one negative, the other positive. The difference of potential between the terminals of every dry cell, regardless of size, is approximately 1.5 volts, whereas the difference of potential between the terminals of a lead storage cell is approximately 2 volts. The larger the cell, the greater is the amount of energy stored within it. The available energy in dry cells becoming exhausted, they are thrown away and new ones are secured, but when storage batteries become exhausted, they are recharged.

The difference of potential between the terminals of any dry or wet cell depends in principle upon the particular chemicals used in its construction, whereas the total charge capacity depends upon the quantity of chemicals present.

The negative terminal of a dry cell is the zinc metal container in which all chemical ingredients are sealed, whereas the positive terminal is a round carbon rod, the end of which protrudes through the surface at one end. The positive electrode of a storage cell is known to be a set of lead grills filled with porous lead dioxide (PbO_2) and fastened together with a single terminal. The negative electrode consists of a set of parallel grills filled with spongy lead (Pb). When these two sets of plates are put together with glass or wood separators and the entire ensemble immersed in dilute sulphuric acid, chemical activity between the lead and acid gives rise to electric charges.

SINGLE-PHASE MOTORS
(Однофазні двигуни)

1. Прочитайте текст та перекладіть українською мовою.

Types of Single-Phase Motors. Great numbers of motors of comparatively small horsepower rating are designed to operate when connected to a single-phase source. Most of them, built in fractional-horsepower sizes, are technically termed small motors, a small motor being defined as "a motor built in a frame smaller than that having a continuous rating of hp, open type, at 1,700 to 1,800 rpm". Single-phase motors are known to perform a great variety of useful services in the home, the office, the factory, in business establishments, on the farm, and many other places where electricity is available. The requirements of the numerous applications differing so widely, the motor-manufacturing industry has developed several types of such machines, each type having operating characteristics that meet definite demands. For example, one operates satisfactorily on direct current or any frequency up to 60 cycles; another rotates at absolutely constant speed, regardless of the load; another develops considerable starting torque; and still another, although not capable of developing much starting torque, is nevertheless extremely cheap to make and very rugged.

The type of motor that performs with about equal satisfaction on direct current or alternating current up to 60 cycles is considered to be the familiar d-c series motor. It is common practice that such motors are generally constructed in small sizes, operate at high speed, and include special design features, so that commutation and armature-reactance difficulties are minimized. Since they may be connected to any of the commonly available sources of supply, they are appropriately referred to as **universal** motors.

The induction principle is applied to several types of single-phase motor. This principle involves the production of a revolving magnetic field, several methods having been developed for doing this in single-phase motors. One of these methods is employed in the shaded-pole motor, an extremely popular small motor used in low-starting-torque applications. The so-called reluctance-start motor is a second type of machine, made in rather limited numbers in small sizes, that utilizes still another method to create the effect of rotating poles.

The **split-phase** type is considered perhaps to be the most widely used of all motors connected to single-phase sources of supply. It is manufactured in a great many sizes and styles, offering the user a choice of a number of desirable operating characteristics. There are, for example, (1) standard split-phase motors, (2) motors that employ a capacitor during the starting period only, and (3) motors that make use of one or more capacitors for starting and running duty. Much excellent design and development work has been done in recent years on this type of machine because of motor manufacturers having felt that the great volume of business justifies their constant improvement.

Repulsion, repulsion induction, and **repulsion-start** motors are other types of single-phase machines that were widely applied until recent years. They have been largely replaced by split-phase motors of the capacitor type because the latter can be designed to perform as well as the repulsion types, offering in addition such advantages as lower cost arid trouble-free service.

Synchronous motors, as the name implies, operate at synchronous speed for all values of load. There are several constructions of such machines, although they are usually manufactured in very small ratings. Depending upon the way in which they are made or their principle of operation, they have special names such as **reluctance** motors, **subsynchronous-reluctance** motors, and **hysteresis** motors.

2. Перекладіть на англійську:

Однофазні мотори, як це випливає із самої назви, розраховані для роботи при підключенні до однофазного джерела живлення. Однофазні мотори мають дуже широке застосування в багатьох місцях, де є в наявності електрична енергія. Для задоволення ряду певних вимог було розроблено багато типів таких машин. Мотор постійного струму працює рівною мірою, як на постійному, так і на переміняємо струмі. Багато однофазних моторів мають багато переваг і ряд бажаних робочих характеристик.

POLYPHASE INDUCTION MOTORS
(Поліфазні індуктивні двигуни)

1. Прочитайте текст та перекладіть українською мовою.

Induction-Motor Principle. In the electric motor, conversion of electrical power (or energy) to mechanical power (or energy) is known to take place in the rotating part of the machine. In the d-c motor and in one type of a-c motors, the electrical power is conducted directly to the rotor through brushes and a commutator; in this respect it is possible to designate such a machine as a conduction motor. In the most common type of a-c motors electrical power is not conducted to the rotor directly; the rotor receives its power inductively in exactly the same way as the secondary of a transformer receives its power. It is for this reason that motors of this type are known as induction motors. In fact, it will become, apparent, as the analysis proceeds, that it will be extremely useful to think of an induction motor as a sort of rotating transformer, i. e., one in which. a stationary winding is connected to the a-c source, while the other winding, mounted on a structure that is free to turn, receives its power by transformer action while it rotates.

The principle of the induction motor was first discovered in 1824, when the following interesting phenomenon was shown: if a non-magnetic disk and a compass are pivoted with their axes parallel, so that one or both of the compass poles are located near the edge of the disk, the compass will rotate if the disk is made to spin, or the disk will rotate if the compass is made to spin. The direction of the induced rotation in one element is always the same as that, imparted to the other. Such an experiment can be readily performed if a simple copper or aluminum disk and a rather large compass are both mounted on the same vertical stem so that each may be rotated in its own bearing independently of the other. There is no more effective way to demonstrate the principle of the induction motor, of which there are several types. If the disk were rotated, the compass would follow at a speed always less than that of the disk; if the compass were rotated, the disk would follow the former at a lower speed.

It should be clearly understood that motor action (rotation of the disk) is developed by induction. The current in the rotor (disk) is the result of electromagnetic induction, which, it will be remembered, requires that there be relative motion between flux and conductors. Thus, if the mechanical load on the rotor increases, the rotor slows down; this slowing down means greater relative motion between flux and rotor, a greater voltage and current, and hence more power to take care of the added load [22]. In other words, the power developed by the rotor automatically adjusts itself to the power required to drive the load.

In the actual motor, the rotor is obviously not a disk, but a well designed structure consisting of a laminated core containing a winding; nor is the main field a single concentrated pole moved by hand, but an even number of poles formed by a distributed winding in a slotted stator. The stator poles are formed by the interaction of the fields of two or three phases, their result being the creation of an effect that is equivalent to a set of revolving poles.

2. Перекладіть питання на англійську та дайте на них відповіді.

1. У якій частині електричного мотора відбувається перетворення електричної енергії в механічну? 2. У якому моторі електрична енергія підводиться прямо до ротора через щітки й колектор? 3. Як ротор одержує свою енергію в більшості моторів змінного струму? 4. Як називаються такі мотори? 5. Як можна продемонструвати принцип індукційного мотора? 6. У результаті чого з'являється струм у роторі? 7. Коли ротор сповільнюється? 8. Що означає таке уповільнення ротора? 9. Із чого складається ротор у даному моторі? 10. Як утворяться полюси статора?

AMMETERS AND VOLTMETERS

1. Прочитайте текст.

The action of almost all the types of measuring instruments is such that an electric current as distinct from an electric potential, is primarily responsible for the ultimate mechanical force required to produce movements of the instrument pointer. This has an exceedingly important influence on the practical forms of ammeters and voltmeters. By this is meant, that all, except the electrostatic type of instrument, are fundamentally current-measuring devices. They are fundamentally ammeters. Consequently, most voltmeters are merely ammeters so designed as to measure small values of current directly proportional to the voltages to be measured. It is only natural, therefore, that voltmeters and ammeters should be classed together.

Ammeters, which are connected in series in the circuit carrying the current to be measured, are of low electrical resistance, this being essential in order that they cause only a small drop of voltage in the circuit being tested, and accordingly absorb a minimum power from it.

Voltmeters are connected across, that is, in parallel with, the circuit points where the voltage is to be measured, and are of high resistance, in this case sufficiently high so that the current flowing in the voltmeter, and the power absorbed from the circuit, are as small as possible.

The principle upon which both of these devices operate is essentially the same as that of the electric motor, differing from the motor, however, in the delicateness of their construction and the restrained motion of the rotating armature.

A coil of fine copper wire is so mounted between the two poles of a permanent magnet that its rotation is restrained by a hairspring. The farther the coil is turned from its equilibrium or zero position, the greater is the restoring force. To this coil is fastened a long pointer at the end of which is a fixed scale reading amperes if it is an ammeter or volts if it is a voltmeter. Upon increasing the current through the moving coil of an ammeter or voltmeter the resultant magnetic field between coil and magnet is distorted more and more. The resulting increase in force therefore turns the coil through a greater and greater angle, reaching a point where it is just balanced by the restoring force of the hairspring.

Whenever an ammeter or voltmeter is connected to a circuit to measure electric current or potential difference, the ammeter must be connected in series and the voltmeter in parallel. As illustrated in Figure 15, the ammeter is so connected that all of the electric current passes through it. To prevent a change in the electric current when making such an insertion, all ammeters must have a low resistance. Hence, most ammeters have a low resistance wire, called a shunt, connected across the armature coil.

A voltmeter, on the other hand, is connected across that part of the circuit for which a measurement of the potential difference is required. The potential difference between the ends of the resistance R1 being wanted, the voltmeter is connected as shown. Should the potential difference across R2 be desired, the voltmeter connections would be made at C and D, whereas if the potential difference maintained by the battery were desired, they would be made at A and D. In order that the connection of a voltmeter to a circuit does not change the electric current in the circuit, the voltmeter must have a high resistance. If the armature coil does not have a large resistance of its own, additional resistance is added in series.

Very delicate ammeters are often used for measuring very small currents too. A meter whose scale is calibrated to read thousandths of an ampere is called a milliammeter, one whose scale is calibrated in millionths of an ampere being known as a microammeter or galvanometer.

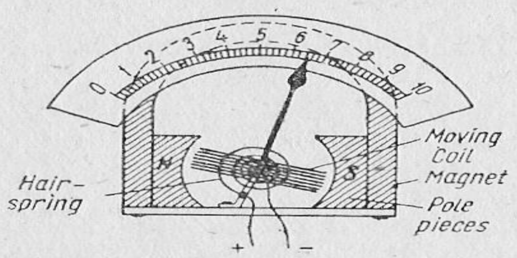

Fig. 14.

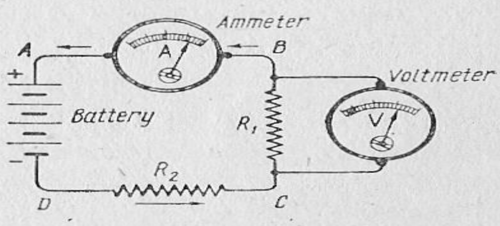

Fig. 15.

2. Перекладіть на англійську:

1. Амперметри, на відміну від вольтметрів, з'єднуються послідовно. 2. У вимірювальних приладах саме електричний струм обумовлює, у першу чергу, виникнення механічної сили. Остання, у свою чергу, викликає рух стрілки приладу. 3. Більшість вольтметрів - це по суті амперметри, призначені для виміру малих струмів, прямо пропорційних вимірюваним напругам. Цим пояснюється те, що вони звичайно перебувають в одному класі вимірювальних пристроїв.

3. Відредагуйте текст, перекладений електронним перекладачем, перекладаючи його на українську мову.

АМПЕРМЕТРЫ И ВОЛЬТМЕТРЫ

Действие почти всех типов измерительных приборов - такое, что электрический ток в отличие от электрического потенциала, является, прежде всего, ответственным за окончательную механическую силу, требуемую для произведения движения указателя инструмента. Это имеет чрезвычайно важное влияние на практические формы амперметров и вольтметров. Под этим подразумевается, что все, кроме электростатического типа инструмента, - по сути измеряющие поток устройства. По сути, они являются амперметрами. Следовательно, большинство - вольтметров являются просто амперметрами, так разработанные, чтобы измерить маленькие значения тока, непосредственно пропорционального напряжениям, которые будут измерены. И поэтому естественно, что вольтметры и амперметры должны классифицироваться вместе.

Амперметры, которые связаны последовательно в электроцепи для замеров, который будет измерен, имеют низкое электрическое сопротивление, это являющийся основой, чтобы они причинили только маленькое снижение{каплю} напряжения в проверяемом кругообороте, и соответственно поглощают минимальную власть{мощь} от этого.

Вольтметры связаны поперек, то есть параллельно с, пункты{точки} кругооборота, где напряжение должно быть измерено, и имеет высокое сопротивление, в этом случае достаточно высоко так, чтобы поток, текущий в вольтметре, и власти{мощи}, поглощенной от кругооборота, - как можно меньше.

Принцип, на который оба из этих устройств работают, по существу тот же самый как это электрического двигателя, отличающегося от двигателя, однако, в утонченности их строительства и ограниченного движения вращающейся арматуры.

Катушка прекрасного медного провода столь установлена между двумя полюсами{поляками} постоянного магнита, что его вращение ограничено hairspring. Чем дальше катушка превращена{направлена} от ее равновесия, или нулевое положение{позиция}, тем больше - сила восстановления. К этой катушке закреплен длинный указатель, в конце которого является установленным масштабом, читая амперы, если это - амперметр или вт, если это - вольтметр. После увеличения потока через двигающуюся катушку амперметра или вольтметра проистекающая магнитная область{поле} между катушкой и магнитом искажена все более. Заканчивающееся увеличение в силе поэтому поворачивает катушку через больший и больший угол, достигая пункта{точки}, где это только сбалансировано силой восстановления hairspring.

Всякий раз, когда амперметр или вольтметр связаны с кругооборотом, чтобы измерить электрический ток или потенциальное различие, амперметр должен быть связан последовательно и вольтметр параллельно. Как иллюстрировано в Фигуре{Числе} 15, амперметр столь связан, что вся электрическая злая собака _ арендует проходы через это. Чтобы предотвращать изменение{замену} в электрическом токе при создании такой вставки, все амперметры должны иметь низкое сопротивление. Следовательно, большинство амперметров имеет низкий провод сопротивления, названный шунтирующимся, связанным поперек катушки арматуры.

Вольтметр, с другой стороны, связан поперек той части кругооборота, для которого измерение потенциального различия требуется. Потенциальное различие между концами сопротивления R1 быть требуемым, вольтметр связан как показано. Если потенциальное различие поперек R2 желательно, связи вольтметра были бы сделаны в C и D, тогда как, если бы потенциальное различие, обслуженное{поддержанное} батареей было желательно, они были бы сделаны в и D. Чтобы связь вольтметра к кругообороту не изменила{не заменила} электрический ток в кругообороте, вольтметр должен иметь высокое сопротивление. Если катушка арматуры не имеет большого сопротивления, собственное, дополнительное сопротивление добавляется последовательно.

Очень тонкие амперметры часто используются для того, чтобы измерить очень маленькие потоки также. Метр, масштаб которого калиброван, чтобы читать тысячные ампера, называют milliammeter, тот, масштаб которого калиброван в миллионных ампера, знать как микроамперметр или гальванометр.

SEMICONDUCTORS
(Напівпровідники)

1. Прочитайте текст та перекладіть українською мовою.
2. Складіть план тексту. Підготуйте переказ.

A good electrical conductor such as copper and an insulator such as steatite differ greatly in electrical conductivity, this difference being of the order of 10^{17} to 10^{19}. Intermediate between these extremes are the semiconductor materials, such as germanium, silicon, selenium, as well as various metallic sulfides and oxides. Of these the most important at present seem to be germanium and silicon.

In a good conductor there are available a large number of relatively free electrons to serve as charge carriers in an electric current. In an insulator all the charges are tightly bound to the atoms and are not available for conduction at normal temperatures. A pure semiconductor at absolute zero has all its charges tightly bound and would behave as an insulator, but as the temperature is raised, a limited number of charges become available for conduction. Because of the number of charge carriers in semiconductors being limited and dependent on temperature, these materials may have conduction properties quite different from those of good conductors. For instance, semiconductors may have a negative temperature coefficient of resistance over some temperature range and may exhibit polarity effects or not be strictly bilateral at a junction with a contacting conductor.

Metals and semiconductors occur in polycrystalline form, the crystal boundaries introducing inconsistencies in conduction from crystal to crystal. For lowered resistance and more consistent conductive properties it has been found desirable to grow large single crystals of a semiconductor from which small wafers are cut. These large single crystals are grown by dipping a small seed crystal into a bath of molten semiconductor and withdrawing the seed at a constant rate as the crystal grows and cools.

The resultant crystal structure has a regular pattern of atom arrangement called a lattice. Silicon and germanium are elements from the fourth group of the periodic table and crystallize in the cubic-lattice form as does carbon in the diamond. Each atom of silicon, of atomic number 14, has its electrons held in groups of energy levels, or shells, containing 2, 8, 4 electrons respectively. The inner shells of 2 and 8 electrons have no excess orbits or energy levels and are stable and complete; the outer 4 electrons are known as valence electrons and contribute to the chemical properties of the atom. Germanium, of atomic number 32, has its electrons held in shells containing 2, 8, 18, 4 electrons and has chemical and electrical properties similar to silicon owing to the four valence electrons in the outer, or incomplete, shell.

Each atom of germanium or silicon in its lattice is joined to its four nearest neighbors by four valence bonds, each having two valence electrons, one from each atom. As a result, each atom is surrounded by a stable shell of eight electrons, the atoms and electrons being held rigidly in place. Since no charges are free to move, then germanium and silicon in this stable condition will behave as insulators. The temperature being raised, kinetic energy is given to the electrons and a few of the valence bonds will be broken and these electrons will become free. At the same time an electron vacancy, or hole, is left in the valence bond, so that actually an electron-hole pair is formed. The hole acts as a positive charge, or is attractive to an electron, and both electron and hole may contribute to current flow under action of an applied electric field. At room temperature germanium may have an intrinsic conductivity of about 1.67 mho per m, even though only about one electron is freed per 10^{10} germanium atoms.

In usual temperature ranges, conduction due to impurity atoms being present in the lattice is of greater importance than that due to intrinsic or thermally released electrons. A few atoms of an element having five valence electrons, such as phosphorus, antimony,-or arsenic from the fifth group of the periodic table, may be introduced into the high-purity germanium. The impurity atom will not be able to form a complete bond; four of its five valence electrons will be found in the germanium bonds, but the fifth will be left relatively free to wander through the crystal and contribute to current conduction. Such conduction is then by negative charges or electrons and is called N-type, the impurity atoms being referred to as donors.

Impurity atoms with three valence electrons from the third group of the periodic table, such as boron, aluminium, gallium, or indium, will incompletely fill the germanium valence bonds and leave a vacancy, or hole, in one bond. Under electric-field attraction an electron may come from a nearby bond and fill this hole. This electron, in turn, leaves a new hole, or vacancy, behind. Effectively, a hole appears to wander about the crystal and will contribute a positive charge to the conduction, which is then referred to as P-type. Such an impurity atom is called an acceptor.

More accurately, it should be stated that the electron takes an additional energy when it is freed from the valence bond. The free electron entering a hole in a valence bond, it releases this excess energy as a quantum of heat or light. The quantum may be reabsorbed by another electron to break its valence bond and create a new electron-hole pair. Conduction by holes differs from that by electrons on account of the freedom of movement, or mobility, of the hole being only about half that of the electron. Mobility μ is defined as velocity per unit applied electric field.

It should be emphasized that throughout the above processes the material remains electrically neutral, and for every electron or hole there is always an opposite charge present in bound or unbound form.

Germanium is a hard, dense material melting at 937°C. It is obtained by reduction of the oxide, which is found in a flue residue from zinc smelting. After extreme purification the germanium melt may be appropriately doped under careful control to yield either N or P germanium, or impurities may be added at proper times as the crystal is being pulled from the melt to give separate layers of N or P conduction. Other methods of controlled diffusion of impurities into the initially purified semiconductor are also employed.

MAGNETS AND MAGNETIC SUBSTANCES
(Магніти та магнітні субстанції)

1. Прочитайте текст та перекладіть українською мовою.
2. Складіть план тексту. Підготуйте переказ.

A magnet may be defined as any body which possesses the property of attracting pieces of iron or steel and which when freely suspended takes up a definite position with respect to the geographical meridian. A magnetic substance is any body which acquires this property when it is placed near a magnet or near a conductor carrying an electric current. A body which is given this property is said to be "magnetized". A magnetic needle is a magnetized needle of iron or steel; the north seeking end of such a needle is referred to as its north pole and the south seeking end as its south pole. A needle is said to be freely suspended when there is no controlling force exerted upon it through its suspension tending to make it take up any definite position. Such a needle being freely suspended near a magnet or a conductor carrying an electric current, a force is bound to be exerted upon it which causes it to take up a definite direction. The needle is said to "point" in the direction of a line drawn through it from its south to its north pole.

Electromagnets and Their Uses
(Електромагніти та їх використання)

1. Прочитайте текст та перекладіть українською мовою.
2. Дайте письмову відповідь на запитання: Where are electromagnets used?

It is easily seen that in a solenoid there is a complete field around each turn. These fields are somewhat modified by the adjacent turns, there being many straight lines coming out from the sides of the coil. Should the coil be wound on a core of soft iron of high permeability, the core would absorb "these straight lines and give a concentrated field from one end of the core to the other. We then have an electromagnet. We use soft iron not only because of its having a high permeability, but because its low retentivity allows very little residual magnetism when the current is turned off. The strength of the magnet increases with the number of amperes flowing and also with the number of turns. The product of amperes and turns is called ampere turns. The strength of an electromagnet with a given core is known to be proportional to the number of ampere turns, the strength of the field depending on the shape of the core. If the poles were brought together into a U shape, the field would become stronger. Of course, the two legs of the U must have opposite poles.

The most obvious use of the electromagnet is in lifting iron weights. They are often capable of holding pieces of iron or steel weighing thousands of pounds; they do not slip, as do hooks and ropes; and they can be operated by the throw of a switch at a distance. We know small, powerful electromagnets to be used by doctors to remove steel particles from the eye. Among the common applications of the electromagnet are the electrical bell, the telephone, the telegraph, radio loud-speaker, circuit breakers, relay for remote control of machines, electrical measuring instruments, motors, and generators.

THE MAGNETIC FIELD
(Магнітне поле)

1. Прочитайте текст та перекладіть українською мовою.
2. Розкажіть про магнітне поле.

Magnets exert a force on some metals. In order to draw some material to itself and hold it in opposition to the law of gravity, the magnetic field must exert a force. There is an invisible magnetic field between the poles of the magnet. This field is considered to be composed of lines of force, and, in as much as force has direction, these lines are thought to be leaving the north pole or end of the magnet and entering the south pole.

Note that the density of the lines is greatest at the poles, and that no line of force crosses another.

This latter phenomenon is the reason why a freely suspended bar magnet will line itself up parallel with the lines of force existing between the north and south magnetic poles of the earth. In the mariner's compass, the end of the magnet that points toward the earth's north geographic pole is called the north pole, the other end being the south pole. If the bar magnet is bent into the shape of a U, it forms the familiar horseshoe magnet. Note that the path of magnetic flow is shortened and intensified.