МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ЧЕРНІГІВСЬКИЙ НАЦІОНАЛЬНИЙ ТЕХНОЛОГІЧНИЙ УНІВЕРСИТЕТ

АНГЛІЙСЬКА МОВА В ЕЛЕКТРОЕНЕРГЕТИЧНІЙ ТА ЕЛЕКТРОТЕХНІЧНІЙ ГАЛУЗЯХ

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до практичних занять
для студентів денної форми навчання
спеціальності 141 “Електроенергетика,
електротехніка та електромеханіка”

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Англійська мова в електроенергетичній та електротехнічній галузях. Методичні вказівки до практичних занять для студентів денної форми навчання спеціальності141 «Електроенергетика, електротехніка та електромеханіка» / Укл. Литвин С.В., Сікалюк А.І., Пермінова В.А. – Чернігів : ЧНТУ, 2018. − 58 с.

Укладачі: ЛИТВИН СВІТЛАНА ВОЛОДИМИРІВНА, завідувач кафедри іноземних мов професійного спрямування, кандидат педагогічних наук, доцент
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Методичні вказівки «Англійська мова в електроенергетичній та електротехнічній галузях» складені у відповідності до вимог Програми викладання англійської мови професійного спілкування (Київ, 2005) та призначені для студентів денної форми навчання напряму підготовки 141 «Електроенергетика, електротехніка та електромеханіка» немовних вузів, які продовжують вивчення англійської мови на базі знань, отриманих в середній школі.

Головна мета методичних вказівок – розвиток умінь, розуміння й аналізу текстів, накопичення словникового запасу, уміння вести бесіду, брати участь у дискусіях англійською мовою, формувати позицію фахівця іноземною мовою в електроенергетичній та електротехнічній галузях.

Методичні вказівки включають 19 тематичних розділів, які містять неадаптовані професійно-орієнтовані тексти, комплекс комунікативно-спрямованих завдань, які сприятимуть кращому оволодінню англійською мовою професійного спрямування, розвитку комунікативних навичок, а також вирішенню професійних завдань засобами іноземної мови.

Методичні вказівки доповнено тлумачним термінологічним словником (Glossary of Common Electrical Terms) для фахівців електроенергетичної та електротехнічної галузей, який представлений у додатку А.

UNIT 1

1.1 Read the text and do the tasks below:

THE NATURE OF ELECTRICITY

Practical electricity is produced by small atomic particles known as electrons. It is the movement of these particles which produce the effects of heat and light.

The pressure that forces these atomic particles to move, the effects they encounter opposition and how these forces are controlled are some of the principles of electricity.

Accepted atomic theory states that all matter is electrical in structure. Any object is largely composed of a combination of positive and negative particles of electricity. Electric current will pass through a wire, a body, or along a stream of water. It can be established in some substances more readily than in others, that all matter is composed of electric particles despite some basic differences in materials. The science of electricity then must begin with a study of the structure of matter. Matter is defined as any substance which has mass (or weight) and occupies space. This definition should be broad enough to cover all physical objects in the universe. Wood, water, iron, and paper are some examples of matter. Energy is closely related to, but not to be confused with, matter. Energy does not have mass, and it does not occupy space. Heat and light are examples of energy.

The smallest particle of matter which can be recognized as an original substance was thought to be a unit called the atom. Recently scientists have found particles even smaller than atoms, but our theories are still based on the atom. The atom consists of a nucleus and a cloud of electrons. It is generally agreed that the electrons are small particles of electricity, which are negative in nature. These particles orbit the nucleus in much the same fashion that planets orbit a sun.

1.2 Guess the meaning of the following international words:

Electricity, electron, effect, structure, combination, material, mass, energy, atom, orbit.

1.3 Give the English equivalents for the words below:

1) виробляти; 2) частка; 3) тепло і світло; 4) напруга; 5) сила; 6) речовина; 7) позитивний; 8) негативний; 9) електричний струм; 10) вага; 11) ядро.

1.4 Translate into Ukrainian the words and expressions from the text:

1) atomic particle; 2) effects of heat and light; 3) encounter opposition; 4) principles of electricity; 5) composed (of); 6) pass through a wire; 7) structure of matter; 8) occupy space; 9) physical objects; 10) a cloud of electrons; 11) in the same fashion.

1.5 Complete the sentences, using the text:

1. Electricity is produced by …
2. The effects of heat and light are produced by …
3. According to the accepted atomic theory all matter is …
4. Any object is composed of …
5. Matter is defined as …
6. Energy must not be confused with …
7. The atom consists of …
8. The smallest particle of matter is …
9. Most theories are based on …
10. Electrons are …

1.6 Answer the questions:

1) What are the principles of electricity? 2) What must the science of electricity begin with? 3) Are there any differences between energy and matter? What are they? 4) What is recognized as an original substance now?

1.7 Topics for discussion:

1. The nature of electricity;
2. The nature of matter;
3. Contents of atomic theory.

UNIT 2

2.1 Read the text and do the tasks below:

ELECTRIC CURRENT

The electric current is a quantity of electrons flowing in a circuit per second of time. The unit of measure for current is ampere. If one coulomb passes a point in a circuit per second then the current strength is 1 ampere. The symbol for current is I.

The current which flows along wires consists of moving electrons. The electrons move along the circuit because the e .m. f. drives them. The current is directly proportional to the e. m. f.

In addition to traveling through solids, however, the electric current can flow through liquids as well and even through gases. In both cases it produces some most important effects to meet industrial requirements. Some liquids, such as melted metals for example, conduct current without any change to themselves. Others, called electrolytes, are found to change greatly when the current passes through them.

When the electrons flow in one direction only, the current is known to be direct current. The simplest source of power for the direct current is a battery, for a battery pushes the electrons in the same direction all the time (i.e., from the negatively charged terminal to the positively charged terminal).

The letters a. c. stand for alternating current. The current under consideration flows first in one direction and then in the opposite one. The a. c. used for power and lighting purposes is assumed to go through 50 cycles in one second.

One of the great advantages of a. c. is the ease with which power at low voltage can be changed into an almost similar amount of power at high voltage and vice versa. Hence, on the one hand alternating voltage is increased when it is necessary for long-distance transmission and, on the other hand, one can decrease it to meet industrial requirements as well as to operate various devices at home.

Although there are numerous cases when d. c. is required, at least 90 per cent of electrical energy to be generated at present is a. c. In fact, it finds wide application for lighting, heating, industrial, and some other purposes.

2.2 Guess the meaning of the following international words:

Electric, ampere, symbol, proportional, industrial, metal, electrolyte, battery, generate.

2.3 Give the English equivalents for the words and word combinations below:

1) текти, протікати; 2) ланцюг, схема; 3) одиниця виміру; 4) провід; 5) електрорушійна сила; 6) тверде тіло; 7) рідина; 8) проводити (струм); 9) джерело енергії; 10) постійний струм; 11) змінний струм; 12) напруга.

2.4 Give Ukrainian equivalents for the following:

1) to meet industrial requirements; 2) melted metals; 3) to push in the same direction; 4) negatively (positively) charged terminal; 5) power and lightning purposes; 6) long-distance transmission; 7) to operate devices; 8) to find wide application.

2.5 Say whether these sentences are true or false:

1. The symbol for current is I.
2. The electric current can flow only through liquids.
3. The current can be of two types: direct current and alternating current.
4. The alternating current flows in one direction.
5. A battery is the simplest source of power for the direct current.
6. Direct current finds wider application than alternating current.
7. Electrolytes don't change greatly when current passes through them.
8. One of the great advantages of alternating current is the ease with which voltage can be changed.

2.6 Fill in the blanks, using the words from the box:

direct current, solids, conduct, electric current, liquids, voltage, alternating current

- ✓ A quantity of moving electrons flowing in a circuit is the a) _____ .
- ✓ The current can flow through b) _____ and c) _____ .
- ✓ Some liquids d) _____ current without any change to themselves.

- ✓ When the electrons flow in one direction only, the current is known to be e) _____ .
- ✓ The current flowing first in one direction and then in the opposite one is f) _____ .
- ✓ Such advantage of alternating current as alternating g) _____ finds wide industrial and household application.

2.7 State the questions to the underlined words:

1. *Melted metals* conduct current without any change to themselves.
2. Alternating voltage can be changed *to operate various devices at home.*
3. A battery pushes the *electrons* in the same direction.
4. *The alternating current* is used for power and lightning purposes.
5. Alternating current accounts for *90 per cent* of electrical energy generated now.

2.8 Speak about the types of electric current and its properties.

UNIT 3

3.1 Read the text and do the tasks below:

EFFECTS PRODUCED BY A CURRENT

The current flow is detected and measured by any of the effects that it produces. There are three important effects accompanying the motion of electric charges: the heating, the magnetic and chemical effects, the latter is manifested under special conditions.

The production of heat is perhaps the most familiar among the principal effects of an electric current. The heating effect of the current is found to occur in the electric circuit itself. It is detected owing to an increase in the temperature of the circuit. This effect represents a continual transformation of electric energy into heat. For instance, the current which flows through the filament of an incandescent lamp heats that filament to a high temperature.

The heat produced per second depends both upon the resistance of the conductor and upon the amount of current carried through it. The thinner the wire is, the greater the developed heat is. On the contrary, the larger the wire is, the more negligible the heat produced is. Heat is greatly desirable at times but at other times it represents a waste of useful energy. It is this waste that is generally called "heat loss" for it serves no useful purposes and decreases efficiency.

The heat developed in the electric circuit is of great practical importance for heating, lighting and other purposes. Owing to it people are provided with a large number of appliances, such as: electric lamps that light our homes, streets and factories, electrical heaters that are widely used to meet industrial requirements, and a hundred and one other necessary and irreplaceable things which have been serving mankind for so many years.

The electric current can manifest itself in some other way. It is the motion of the electric charges that produces the magnetic forces. A conductor of any kind carrying an electric current, a magnetic field is set up about that conductor.

This effect exists always whenever an electric current flows, although in many cases it is so weak that one neglects it in dealing with the circuit. An electric charge at rest does not manifest any magnetic effect. The use of such a machine as the electric motor has become possible owing to the electromagnetic effect.

The last effect to be considered is the chemical one. The chemical effect is known to occur when an electric current flows through a liquid. Thanks to it a metal can be transferred from one part of the liquid to another. It may also effect chemical changes in the part of the circuit comprising the liquid and the two electrodes which are found in this liquid. Any of the above mentioned effects may be used for detecting and measuring current.

3.2 Give the English equivalents for the following words:

1) виявляти; 2) лампа розжарювання; 3) вимірювати; 4) прилад; 5) заряд; 6) втрата енергії; 6) нитка розжарення; 7) висвітлювати; 8) тепловий ефект; 9) проявлятися.

3.3 Guess the meaning of the following international words:

transformation, temperature, chemical, magnetic, special, practical, motor, electrode.

3.4 Insert words and expressions:

1. The current flow is (виявляється та вимірюється) by any of the effects that it produces.
2. There are three important effects accompanying the motion of (електричні заряди).
3. The current which flows through the (нитка розжарення лампи розжарювання) heats that filament to a high temperature.
4. Heat represents (втрату корисної енергії) at times.
5. Electric lamps (освітлюють) our homes, streets and factories.
6. The electric current can (проявляти) magnetic effect.

3.5 Choose the correct translation:

The heating effect of the current is found to occur in the electric circuit itself.

1. Встановлено, що тепловий ефект електричного струму виявляється в самому електричному колі.
2. Тепловий ефект електричного струму може з'являтися в самому електричному колі.
3. Встановлено, що тепловий ефект електричного струму має виявлятися в в самому електричному колі.

Коли в будь-якому провіднику з'являється електричний струм, навколо нього виникає магнітне поле.

1. A conductor of any kind carrying an electric current, a magnetic field was set up about that conductor.
2. A conductor of any kind have been carrying an electric current, a magnetic field is set up about that conductor.

3. A conductor of any kind carrying an electric current, a magnetic field is set up about that conductor.

Останній ефект, який необхідно розглянути - хімічний ефект.

1. The last effect is considered to be the chemical one.
2. The last effect to be considered is the chemical one.
3. The last effect would be considered the chemical one.

Відомо, що хімічний ефект виникає, коли електричний струм проходить через рідину.

1. The chemical effect is known to occur when an electric current flows through a liquid.
2. The chemical effect is famous to occur when an electric current flows through a liquid.
3. The chemical effect may be known to occur when an electric current flows through a liquid.

Саме рух електричних зарядів породжує магнітні сили.

1. The motion of the electric charges produces the magnetic forces.
2. It is the motion of the electric charges that produces the magnetic forces.
3. The motion of the electric charges is certain to produce the magnetic forces.

3.6 Answer the questions:

1. What effects does the current flow produce?
2. How is the heating effect detected?
3. What does the heat produced depend upon?
4. What is called “heat loss”?
5. How is the magnetic effect set up?
6. What is the main condition of the magnetic effect existence?
7. When does the chemical effect occur?

3.7 Speak about the principal effects of an electric current.

UNIT 4

4.1 Read the text and do the tasks below:

ELECTRIC CURCUITS

The concepts of electric charge and potential are very important in the study of electric currents. When an extended conductor has different potentials at its ends, the free electrons of the conductor itself are caused to drift from one end to the other. The potential difference must be maintained by some electric source such as electrostatic generator or a battery or a direct current generator. The wire and the electric source together form an electric circuit, the electrons are drifting around it as long as the conducting path is maintained.

There are various kinds of electric circuits such as: open circuits, closed circuits, series circuits, parallel circuits and short circuits. To understand the difference between the following circuit connections is not difficult at all. If the circuit is broken or «opened» anywhere, the current is known to stop everywhere. The circuit is broken when an electric device is switched off. The path along which the electrons travel must be complete otherwise no electric power can be supplied from the source to the load. Thus the circuit is "closed" when an electric device is switched on.

When electrical devices are connected so that the current flows from one device to another, they are said «to be connected in series». Under such conditions the current flow is the same in all parts of the circuit as there is only a single path along which it may flow. The electrical bell circuit is considered to be a typical example of a series circuit. The "parallel" circuit provides two or more paths for the passage of current. The circuit is divided in such a way that part of the current flows through one path and part through another. The lamps in the houses are generally connected in parallel.

The "short" circuit is produced when the current can return to the source of supply without control. The short circuits often result from cable fault or wire fault. Under certain conditions the short circuit may cause fire because the current flows where it was not supposed to flow. If the current flow is too great a fuse is used as a safety device to stop the current flow.

4.2 Guess the meaning of the following international words:

Concept, potential, electrostatic generator, aluminum, parallel, typical, control.

4.3 Give the English equivalents for the following words and word combinations:

1) електричні ланцюги; 2) електричний заряд; 3) провідник; 4) опір; 5) рух електронів; 6) ізолятор; 7) коротке замикання; 8) енергія.

4.4 Say whether these sentences are true or false:

1. When an extended conductor has the same potential at its ends, free electrons are drifting from one end to another.
2. The wire and the electric source together form an electric circuit.
3. A path of any material will allow current to exist.
4. Silver, copper and gold oppose very strongly.
5. The slighter the opposition is, the better the insulator is.
6. There is only one type of electric circuit.
7. We close the circuit when we switch on our electric device.

4.5 Complete the sentences, using the text:

1. The potential difference must be maintained by …
2. Materials that offer slight opposition are called …
3. The best insulators are …
4. There are various kinds of electric circuits such as …
5. We “open” the circuit when …
6. We “close” the circuit when …
7. The “short” circuit is produced when …
8. A fuse is …

4.6 Answer the questions:

1. What concepts are very important in study of electric current?

2. What forms an electric circuit?

3. What materials are the best conductors and insulators?

4. What kinds of electric circuits do you know?

5. How can we open and close the circuit?

6. When are electrical devices connected in series?

7. What is an example of a series circuit?

8. What can you say about «parallel» circuits?

9. What does the short circuit often result from?

4.7 Speak about the types of electric circuits.

UNIT 5

5.1 Read the text and do the tasks below:

ALTERNATING CURRENT

Current is defined as increment of electrons. The unit for measuring current was named in honor of A.M. Ampere, the French physicist. Thus it is called ampere. The symbol for current is I. The electric current is a quantity of electrons flowing in a circuit per second of time. The electrons move along the circuit because the e. m. f. drives them. The current is directly proportional to the e. m. f.

A steam of electrons in a circuit will develop a magnetic field around the conductor along which the electrons are moving. The strength of the magnetic field depends upon the current strength along the conductor. The direction of the field is dependent upon the direction of the current.

If the force causing the electron flow is indirect, the current is called direct (d. c.). If the force changes its direction periodically the current is called alternative (a. c.).

Alternating current is the current that changes direction periodically. The electrons leave one terminal of the power supply, flow out along the conductor, stop, and then flow back toward the same terminal. A voltage that caused current reverses its polarity periodically. This is properly called an alternating voltage. The power

supply that provides the alternating voltage actually reverses the polarity of its terminals according to a fixed periodic pattern. A given terminal will be negative for a specific period of time and drive electrons out through the circuit. Then, the same terminal becomes positive and attracts electrons back from the circuit. This voltage source cannot be a battery. It must consist of some types of rotating machinery.

5.2 Guess the meaning of the following international words:

Physicist, ampere, symbol, second, polarity, period, battery.

5.3 Translate into Ukrainian the words and expression from the text:

1) increment of electrons; 2) measuring; 3) to drive; 4) directly proportional; 5) conductor; 6) strength; 7) causing force; 8) terminal; 9) to flow; 10) to reverse.

5.4 Give the English equivalents for the words below:

1) змінний струм; 2) за секунду; 3) кількість електронів; 4) потік електронів; 5) магнітне поле; 6) напрямок; 7) залежати від; 8) посилення; 9) джерело напруги; 10) ротаційний механізм.

5.5 Complete the sentences, using the text:

1. The electric current is …
2. The unit for measuring current is …
3. A steam of electrons in a circuit will develop …
4. The current is called direct if …
5. The current is called alternating if…
6. Alternating voltage is …
7. Alternating voltage source cannot be …

5.6 Answer the questions:

1. Why do electrons move along the circuit?
2. What does the strength of the magnetic field depend upon?

3. What does the direction of the field depend upon?

4. What is the way of alternating current electrons?

5. How does the alternating voltage power supply reverse the polarity of terminals?

5.7 Talk on the properties of the electric current and its types.

UNIT 6

6.1 Read the text and do the tasks below:

CONDUCTORS AND INSULATORS

All substances have some ability of conducting the electric current, however, they differ greatly in the ease with which the current can pass through them. Solid metals conduct electricity with ease while non-metals do not allow it to flow freely. Thus, there are conductors and insulators. What do the terms "conductors" and "insulators" mean? This difference is expressed by what is called electrical conductivity of the body. It depends upon the atomic constitution of the body. Substances through which electricity is easily transmitted are called conductors. Any material that strongly resists the electric current flow is known as an insulator.

Conductance, that is the conductor's ability of passing electric charges, depends on the four factors: the size of the wire used, its length and temperature as well as the kind of material to be employed. A large conductor will carry the current more readily than a thinner one. To flow through a short conductor is certainly easier for the current than through a long one in spite of their being made of similar material. Hence, the longer the wire, the greater is its opposition, that is resistance, to the passage of current.

There is a great difference in the conducting ability of various substances. Almost all metals are good electric current conductors. The best conductors are silver, copper, gold and aluminum. Nevertheless, copper carries the current more freely than iron; and silver, in its turn, is a better conductor than copper. Copper is the most

widely used conductor. The electrically operated devices are connected to the wall socket by copper wires.

A material which resists the flow of the electric current is called an insulator. The higher the opposition is, the better the insulator is. There are many kinds of insulation used to cover the wires. The kind used depends upon the purposes the wire or cord is meant for. The insulating materials generally used to cover the wires are rubber, asbestos, glass, plastics and others. The best insulators are oil, rubber and glass. Rubber covered with cotton, or rubber alone is the insulating material usually used to cover desk lamp cords and radio cords. Glass is the insulator to be often seen on the poles that carry the telephone wires in city streets. Glass insulator strings are usually suspended from the towers of high voltage transmission lines. One of the most important insulators of all, however, is air. That is why power transmission line wires are bare wires depending on air to keep the current from leaking off.

Conducting materials are by no means the only materials to play an important part in electrical engineering. There must certainly be a conductor, that is a path, along which electricity is to travel and there must be insulators keeping it from leaking off the conductor.

6.2 Give the Ukrainian equivalents for the words and word combinations below:

1) conductors; 2) insulators; 3) transmit; 4) resistance; 5) passage of current; 6) socket; 7) to connect to; 8) cord; 9) high voltage transmission line; 10) leak off.

6.3 Find in the text the sentences with the following related words and translate them:

conducting – conductor – conductivity – conductance

6.4 State questions to the underlined words:

1) *Solid metals* conduct electricity with ease.

2) Conductance depends on the *four factors*.

3) There are *many kinds of insulation* used to cover the wires.

4) *Insulators* keep electricity from leaking off the conductor.

5) *Conductors* play an important role in electrical engineering.

6.5 Say whether these sentences are true or false:

1) Electrical conductivity of a body depends upon its atomic constitution.

2) There is no difference in the conducting ability of various substances.

3) The longer the wire is the weaker its opposition is.

4) The kind of the insulating material depends upon the purpose it is meant for.

5) Conductors are substances through which electricity is easily transmitted.

6) Insulators do not allow the electric current to flow freely.

6.6 Talk on the conducting ability of various substances and their appliance in electrical engineering.

UNIT 7

7.1 Read the text and do the tasks below:

SEMICONDUCTORS

There are materials that really occupy a place between the conductors of the electric current and the non-conductors. They are called semiconductors. These materials conduct electricity less readily than conductors but much better than insulators.

Semiconductors include almost all minerals, many chemical elements, a great variety of chemical compounds, alloys of metals, and a number of organic compounds. Like metals, they conduct electricity but they do it less effectively.

In metals all electrons are free and in insulators they are fixed. In semiconductors electrons are fixed, too, but the connection is so weak that the heat motion of the atoms of a body easily pulls them away and sets them free.

Minerals and crystals appear to possess some unexpected properties. It is well known that their conductivity increases with heating and falls with cooling.

As a semiconductor is heated, free electrons in it increase in number, hence, its conductivity increases as well.

Heat is by no means the only phenomenon influencing semiconductors. They are sensitive to light, too. Take germanium as an example. Its electrical properties may greatly change when it is exposed to light. With the help of a ray of light directed at a semiconductor, we can start or stop various machines, effect remote control, and perform lots of other useful things. Just as they are influenced by falling light, semiconductors are also influenced by all radiation.

Generally speaking, they are so sensitive that a heated object can be detected by its radiation.

Such dependence of conductivity on heat and light has opened up great possibilities for various uses of semiconductors. The semiconductor devices are applied for transmission of signals, for automatic control of a variety of processes, for switching on engines, for the reproduction of sound, protection of high-voltage transmission lines, speeding up of some chemical reactions, and so on. On the one hand they may be used to transform light and heat energy directly into electric energy without any complex mechanism with moving parts, and on the other hand, they are capable of generating heat or cold from electricity.

Ukrainian engineers and scientists turned their attention to semiconductors many years ago. They saw in them a means of solving an old engineering problem, namely, that of direct conversion of heat into electricity without boilers or machines. Semiconductor thermocouples created in Ukraine convert heat directly into electricity just as a complex system consisting of a steam boiler, a steam engine and a generator does it.

7.2 Give the English equivalents for the words and word combinations below:

1) напівпровідник; 2) хімічна сполука; 3) сплав; 4) звільняти; 5) властивість; 6) збільшувати(ся); 7) охолодження; 8) чутливий до; 9) виставляти; 10) промінь; 11) направляти на; 12) дистанційне керування; 13) знаходити, виявляти;

14) захист; 15) прискорення; 16) вирішити інженерну проблему; 17) термоелемент.

7.3 Guess the meaning of the following international words:

Element, organic, mineral, crystal, phenomenon, automatic, control, process, reproduction, conversion, boiler.

7.4 Complete the sentences:

1. Semiconductors are sensitive to …
2. Semiconductors convert heat into …
3. Semiconductors occupy a place between…
4. Semiconductors conduct electricity …
5. As a semiconductor is heated …

7.5 Insert words and expressions:

1) Semiconductors include a great variety of (хімічні сполуки), (сплави металів).

2) Minerals and crystals appear to possess some unexpected (властивості). Their conductivity increases with (нагрівання) and falls with (охолодження).

3) With the help of a ray of light directed at a semiconductor, we can effect (дистанційне управління).

4) The semiconductor devices are applied for (автоматичний контроль) of a variety of processes, for the (відтворення) of sound, (прискорення) of some chemical reactions.

5) (Термоелементи) created in Ukraine convert heat directly into electricity.

7.6 Answer the questions:

1) What do semiconductors include?

2) How does the atomic structure of semiconductors influence their properties?

3) What phenomena influence semiconductors?

4) What are the semiconductor devices applied for?

5) How do semiconductors help in solving engineering problems?

7.7 Talk on the properties of semiconductors and their practical application

UNIT 8

8.1 Read the texts and do the tasks below:

ELECTRICITY AND MAGNETISM

Text 1. Electromotive force

When free electrons are dislodged from atoms, electrical energy is released.

Chemical reaction, friction heat and electromagnetic induction will cause electrons to move from one atom to another. Whenever energy in any form is released, a force called electromotive (e. m. f.) is developed. If the force exerts its effort always in one direction, it is called direct; and if the force changes its direction of exertion periodically, it is called alternating.

The chemical reaction in a dry cell, heat and friction are sources of a unidirectional force. Electromagnetic induction produces an alternating force. The direction of force depends on the direction in which the field is cut. Whenever an e. m. f. is developed, there is also a field of energy called an electrostatic field, which can be detected by an electroscope and measured by an electrometer.

Text 2. Electromagnetic Induction

An electromotive force is induced in the conductor when there is a change in the magnetic field surrounding a conductor. This induced electromotive force may be produced in several ways as follows:

a. A conductor may move in a stationary magnetic field of constant strength.

b. A stationary conductor may be exposed 'to a moving magnetic field of constant strength.

c. The strength of the field surrounding the conductor may change without any motion of conductor or magnetic circuit.

The electromotive force induced by motion of a conductor or a magnetic flux is the same when the conductor rotates and the flux is stationary or the flux rotates and the conductor is stationary. If both, conductor and flux, rotate in the same direction at the same speed, no electromotive force will be produced, if they rotate at the same speed but in opposite directions, the electromotive force induced would be twice as that which would be induced, if one of them was stationary. An electromotive force is not induced when a conductor is moved parallel to the lines of force, but only when it moves at an angle with these lines.

Any motion across the direction of the lines, however, will produce an electromotive force in the conductor. For this reason, the conductor is said to «cut» the lines of force. The actual electromotive force induced in the conductor depends upon the nature at which the flux is cut.

Text 3. Electromotive force and resistance

The electromotive force is the very force that moves the electrons from one point in an electric circuit towards another. In case this e. m. f. is direct, the current is direct. On the other hand, were the electromotive force alternating, the current would be alternating, too. The e. m. f. is measurable and it is the volt that is the unit used for measuring it. A current is unable to flow in a circuit consisting of metallic wires alone. A source of an e. m. f. should be provided as well. The source under consideration may be a cell or a battery, a generator, a thermocouple or a photocell, etc.

In addition to the electromotive force and the potential difference reference should be made to another important factor that greatly influences electrical flow, namely, resistance. All substances offer a certain amount of opposition, that is to say resistance, to the passage of current. This resistance may be high or low depending on the type of circuit and the material employed. Glass and rubber offer a very high resistance and, hence, they are considered as good insulators. All substances do allow the passage of some current provided the potential difference is high enough.

Certain factors can greatly influence the resistance of an electric circuit.

They are the size of the wire, its length, and type. In short, the thinner or longer the wire, the greater is the resistance offered.

8.2 Give the English equivalents for the words below. Find in the text the sentences with these words and translate them.

1) тертя; 2) електрорушійна сила; 3) елемент; 4) паралельне з'єднання; 5) опір; 6) електромагнітна індукція; 7) змінний струм; 8) постійна напруга; 9) фотоелемент.

8.3 Guess the meaning of the following international words and translate them:

Reaction, electrostatic, electrometer, electroscope, volt, metallic.

8.4 Say whether these sentences are true or false:

1. Alternating force always exerts its effort in one direction.
2. Alternating force is produced by electromagnetic induction.
3. The electromotive force is induced by motion of a conductor.
4. Resistance is an important factor that greatly influences electrical flow.
5. The type of the material employed doesn’t influence the resistance.

8.5 Answer the questions:

1) What factors cause the motion of electrons from one atom to another?
2) When is the electromotive force developed?
3) When does an electrostatic field appear?
4) How is the electromotive force induced?
5) What unit is used for measuring the electromotive force?
6) What are the sources of electromotive force?
7) What is called “resistance”?
8) How do the types of circuit and material influence the resistance?
9) Name the factors that influence the resistance.

UNIT 9

9.1 Read the text and do the tasks below:

DYNAMOS

The term «dynamo» is applied to machines which convert either mechanical energy into electrical energy or electrical energy into mechanical energy by utilizing the principle of electromagnetic induction. A dynamo is called a generator when mechanical energy supplied in the form of rotation is converted into electrical energy. When the energy conversion takes place in the reverse order the dynamo is called a motor. Thus a dynamo is a reversible machine capable of operation as a generator or motor as desired.

A generator does not create electricity, but generates or produces an induced electromotive force, which causes a current to flow through a properly insulated system of electrical conductors external to it. The amount of electricity obtainable from such a generator is dependent upon the mechanical energy supplied. In the circuit external to a generator the e. m. f. causes the electricity to flow from a higher or positive potential to a lower or negative potential. In the internal circuit of a generator the e. m. f. causes the current to flow from a lower potential to a higher potential. The action of a generator is based upon the principles of electromagnetic induction.

The dynamo consists essentially of two parts: a magnetic field, produced by electromagnets, and a number of loops or coils of wire wound upon an iron core, forming the armature. These parts are arranged so that the number of the magnetic lines of force of the field threading through the armature, coils will be constantly varied, thereby producing a steady e. m. f. in the generator or a constant torque in the motor.

9.2 Fill in the gaps with the words given below:

to convert, generator, reversible, obtainable, induction, loops

1. The term “dynamo” is applied to machines which … either mechanical energy into electrical or on the contrary electrical energy into mechanical energy.

2. A dynamo is a … machine capable of operation as a generator or motor as desired.

3. The amount of electricity ... from such a generator is dependent upon the mechanical energy supplied .

4. The action of a generator is based upon the principles of electromagnetic ... .

5. The dynamo consists of two parts: a magnetic field, produced by electromagnets, and a number of ... or coils of wire.

9.3 Find the Ukrainian equivalents for the following English words and word combinations:

1) to be applied to smth.; 2) to convert smth. into smth.; 3) rotation; 4) to utilize;

5) a properly insulated system; 6) internal (external) circuit; 7) capable of operation;

8) positive (negative) potential; 9) reverse order; 10) energy conversion.

9.4 Answer the questions:

1. What term can be applied to machines converting mechanical energy into electrical?

2. What kind of machine is a dynamo?

3. What is the function of a generator?

4. What is the action of a generator based upon?

5. What parts does the dynamo consist of?

UNIT 10

10.1 Read the text and do the tasks below:

GENERATORS

The powerful, highly efficient generators and alternators that are in use today operate on the same principle as the dynamo invented by the great English scientist Faraday in 1831. Dynamo-electric machines are used to supply light, heat and power on a large scale. These are the machines that produce more than 99.99 per cent of all the world's electric power.

There are two types of dynamos – the generator and the alternator. The former supplies d. c. which is similar to the current from a battery and the latter provides a. c. To generate electricity both of them must be continuously provided with energy from some outside source of mechanical energy such as steam engines, steam turbines or water turbines.

A generator is an electric machine, which converts mechanical energy into electric energy. There are direct-current (d. c.) generators and alternating current (a. c.) generators. Their construction is much alike. A d. c. generator consists of stationary and rotating elements. The stationary elements are: the yoke or the frame and the field structure. The yoke forms the closed circuit for the magnetic flux. The function of the magnetic structure is to produce the magnetic field.

The rotating elements are: true armature and the commutator. They are on the same shaft. The armature consists of the core and the winding. The winding is connected to the commutator. With the help of the brushes on the commutator that conduct the electric current to the line the winding is connected to the external circuit. The stationary element of an a. c. generator is called a stator. The rotating element is called a rotor. The essential difference between a d. c. generator and a. c. generator is that the former has a commutator by means of which the generated e. m. f. is made continuous, i. e. the commutator mechanically rectifies the alternating e. m. f. so that it is always of the same polarity.

D. c. generators are used for electrolytic processes such as electroplating. Large d. c. generators are employed in such manufacturing processes as steel making. The d. c. generator of small capacities is used for various special purposes such as arc welding, automobile generators, train lighting systems, etc. It also finds rather extensive use in connection with communication systems.

10.2 Give the Ukrainian equivalents for the following English words and word combinations:

1) generator; 2) alternator; 3) steam turbine; 4) water turbine; 5) armature; 6) rotor; 7) stationary; 8) commutator; 9) stator; 10) yoke; 11) brushes; 12) core; 13) frame; 14) winding.

10.3 Fill in the blanks:

1. A generator is an electric machine, which … mechanical energy into electrical energy.
2. A direct-current generator consists of … .
3. The dynamo was invented by … in 1831.
4. The d.c. generator is used for various purposes such as … .

10.4 Work out the plan of the text.

10.5 Speak on the following points:

1. The construction of a generator.
2. The direct current generators and their industrial application.

UNIT 11

11.1 Read the text and do the tasks below:

MAIN STRUCTURAL ELEMENTS OF A D. C. MACHINE

A direct-current machine consists of two main parts, a stationary part, usually called the stator, designed mainly for producing a magnetic flux, and a rotating part, called the armature or the rotor. The stationary and rotating parts should be separated from each other by an air-gap. The stationary part of a d. c. machine consists of main poles, designed to create the main magnetic flux; commutating poles interposed between the main poles; and a frame. It should be noted here that sparkles operation of the machine would be impossible without the commutating poles. Thus, they should ensure sparkles operation of the brushes at the commutator.

The main pole consists of a laminated core the end of which facing the armature carries a pole shoe and a field coil through which direct current passes. The armature is a cylindrical body rotating in the space between the poles and comprising a slotted armature core, a winding inserted in the armature slots, a commutator, and a brush gear.

The frame is the stationary part of the machine to which are fixed the main and commutating poles and by means of which the machine is bolted to its bedplate. The ring shaped portion which serves as the path for the main and commutating pole fluxes is called the yoke. End-shields or frame-heads which carry the bearings are also attached to the frame. Of these main structural elements of the machine the yoke, the pole cores, the armature core and the air-gap between the armature core and the pole core are known to form the magnetic circuit while the pole coils, the armature windings, the commutator and brushes should form the electric circuit of the machine.

11.2 Translate into Ukrainian the following phrases:

To consist of a stationary part and a rotating part; the stationary and rotating parts should be separated from each other by an air gap; the ring shaped portion or yoke serves as a path for the main and commutating pole fluxes.

11.3 Arrange synonyms in pairs and memorize them:

a) to consist of; to be separated from; to create; to be interposed between; to pass; to rotate;

в) to be divided with; to produce; to introduce into; to permeate; to roll; to revolve; to comprise.

11.4 Write out the names of the machine parts and describe their operational characteristics.

UNIT 12

12.1 Read the text and do the tasks below:

THE ALTERNATOR

The alternator is an electric machine for generating an alternating current by a relative motion of conductors and a magnetic field. The machine usually has a rotating field and a stationary armature. In a synchronous alternator the magnetic field is excited with a direct current. The direction of an induced e. m. f. is reversed each time when a conductor passes from a pole of one polarity to a pole at another polarity. Most machines of this type are used for lighting and power, but there are alternators with a revoking armature and a stationary field. They are used in small sizes mostly for special purposes.

Any electrical machine is reversible. When a machine is driven by a source of mechanical power, it works as a generator and delivers electrical power. If it is connected to a source of electrical power, it produces mechanical energy, and operates as a motor. The alternator may also be operated as a motor.

The a-c .generator, or alternator, does not differ in principle from the d. c. generator. The alternator consists of a field structure and an armature. The field structure is magnetized by a field winding carrying a .direct current. An electromotive force is generated in tine winding of the armature. In alternators the field is usually the rotating element and the armature is stationary. This construction has a number of advantages. Only two rings are needed with a rotating field. These rings carry only a relatively light field current, at a voltage generally of 125, and seldom exceeding 250. The insulation of such rings is not difficult. A stationary armature requires no slip rings. The leads from the armature can be continuously insulated from the armature winding to the switchboard, leaving no bare conductor. The alternator with a rotating field may be further divided into the vertical and the horizontal types.

The vertical type is usually applied for large water-wheel generators where it is desirable to mount the water turbine below the generator. The more common horizontal type is used with diesel and steam engine drive. A low speed alternator of

this type is suitable for a diesel engine drive, a high speed alternator is suitable for a steam turbine drive.

12.2 Form nouns, denoting devices with the help of the suffix *-or* and translate them.

To alternate, to commute, to conduct, to generate.

12.3 Skim the text again and write out the keywords, characterizing the alternator.

12.4 Translate the following word combinations, paying attention to the Participle 2.

The leads from the armature can be continuously insulated from; the vertical type of alternator applied for large water-wheel generator; alternators with a revoking armature and a stationary field used in small sizes mostly for special purposes; a machine driven by a source of mechanical power; the direction of the induced e. m. f.

12.5 State 5 questions to the text «The Alternator».

12.6 Points for discussion:

1. The structure of the alternator.
2. The application of the alternator.

UNIT 13

13.1 Read the text and do the tasks below:

THE INDUCTION MOTOR

An induction motor like any other motor consists of a stationary part, the stator, and a rotating part, the rotor. The rotor of an induction motor is not connected electrically to the source of power supply. The currents which circulate in the rotor

conductors are the result of voltage induced in the rotor in the magnetic field set up by the stator. The rotor is fitted with a set of conductors in which currants flow. As these conductors lie in the magnetic field produced by the stator, a force is exerted on the conductors and the rotor begins to revolve. The operation of the motor depends upon the production of a rotating magnetic field. The speed at which the field of an induction motor turns is called the synchronous speed of the field or of the motor.

The induction motor is the simplest of the various types of electric motors and it has found more extensive application in industry than any other type. It is made in two forms – the squirrel cage and the wound rotor, the difference being in the construction of the rotor.

The stator of the induction motor has practically the same slot and winding arrangement as the alternator and has the coils arranged to form a definite number of poles, the number of poles being a determining factor in connection with the speed at which the motor will operate. The rotor construction, however, is entirely different.

The squirrel-cage rotor is a simpler form and has been used in many machines.

Instead of coils the winding consists of heavy copper bars.

The wound-rotor type has a winding made up of well-insulated coils, mounted in groups whose end connections are brought out to fill in rings. The purpose of this winding is to provide for variation in the amount of resistance included in the rotor circuit.

Provision for ventilation is made by leaving passageways through the core and frame, through which air is forced by fan vanes mounted on the rotor. In main cases the motors now built in as an integral part of the machine it is to drive.

There being no electrical connection between the rotor circuits of the induction motor and the stator circuits, or supply line, the currents which flow in the rotor bars or windings correspond to the induced voltages, the action being similar to that of a transformer with a movable secondary. With, but a single phase winding on the stator, however, the torques produced in the two halves of the rotor would be in apposition, and the motor would not start. With more than one set of windings two for a two-phase motor, three for a three-phase motor a resultant field is produced

which has the effect of cutting across the rotor conductors and induces voltages in them. This field is considered to be revolving at uniform speed.

The term “revolving field” should not be taken to mean actual revolution of flux lines. The magnetic field from the coils of each phase varies in strength with changes in current value but does not move around the stator. The revolutions are those of the resultant of the three, or two, phases, as the case may be.

A motor with a single-phase winding is not self-starting but must be provided with an auxiliary device of some kind to enable the motor to develop a starting torque. The effect of the revolving field is the same as would result from actual revolution of a stator having direct-current poles. As voltages have been induced in the bars or windings of the rotor, currants start flowing as a result of these voltages, and a torque is produced which brings the motor up to speed.

13.2 Find in the text the English equivalents for the word combinations given below:

1) асинхронний двигун; 2) нерухома частина; 3) частина, що обертається; 4) провідник; 5) одночасна швидкість; 6) широке застосування; 7) паз; 8) механізм обмотки; 9) трансформатор; 10) момент, що обертається.

13.3 Complete the following sentences according to the contents of the text:

1. The Induction Motor is … of electric motors and is more extensively applied in industry than any other type.
2. The purpose of this winding is … for variation in the amount of resistance included in the rotor circuit.
3. The effect of … is the same as would result from actual revolution of a stator having direct-current poles.

13.4 Answer the following questions:

1. What parts does the induction motor consist of?
2. What are the names of its rotating and stationary parts?

3. What does the motor operation depend on?

4. How can the difference between stator and rotor construction be explained?

5. What does the term “revolving field” mean?

13.5 Translate the sentences from the text, paying attention to the Participle Constructions:

1. The induction motor is made in two forms – the squirrel cage and the wound rotor, the difference being in the construction of the rotor.

2. The stator of the induction motor has practically the same slot and winding arrangement as the alternator and has the coils arranged to form a definite number of poles, the number of poles being a determining factor in connection with the speed at which the motor will operate.

3. There being no electrical connection between the rotor circuits of the induction motor and the stator circuits, or supply line, the currents which flow in the rotor bars or windings correspond to the induced voltages, the action being similar to that of a transformer with a movable secondary.

13.6 Discuss the following points:

1) The construction of an induction motor.

2) Induction motor operation principle.

UNIT 14

14.1 Read the texts and do the tasks below:

TYPES OF INDUCTION MOTORS

Text 1. Single-Phase Motor

The single-phase induction motor differs from poly-phase type principally in the character of its magnetic field, as an ordinary single-phase winding will not produce a rotating field, but a field that is oscillating, and the induced currents and poles produced in the rotor by this field will tend to produce equal torque in opposite

directions, therefore, the rotor cannot start to revolve. However, if the rotor can in some manner be made to rotate at a speed corresponding to the frequency of the current in the stator windings then the reaction of the stator and rotor flux is such as to produce a torque that will keep the rotor revolving.

In practice the starting of single-phase induction motors is accomplished by three general methods applicable to small-sized motors only.

First: the split-phase method, in which an auxiliary stator winding is provided for starting purposes only, this winding being displaced from the main stator winding by 90 electrical degrees. It has a higher inductance than the main stator winding, thus causing the currant in it to lag far enough behind the current in the main winding to produce a shifting or rotating field during the starting period, which exerts a starting torque on the rotor sufficient to cause rotation.

When nearly normal speed has been reached the auxiliary winding is out of circuit by a switch and clutch in the motor, which operates automatically by centrifugal force, and the rotor continues to run as a single-phase motor. The starting torque of such motions being limited, they are frequently constructed with the rotor arranged to revolve freely on the shaft at starting until nearly normal speed is reached, at which time the load is pitched up by the automatic action of a centrifugal clutch.

Second: an auxiliary winding may be connected to the single-phase line through an external inductance and a switch (for disconnecting the auxiliary winding from the circuit after the motor has reached normal speed), the introduction of the inductance in the auxiliary winding splitting the phase as before.

Text 2. Three-Phase Induction Motor

The three-phase induction motor is the most commonly used type. It has been widely used in recent years. Normally an induction motor consists of a cylindrical core (the stator) which carries the primary coils in slots on its inner periphery. The primary coils are arranged for a three-phase supply and serve to produce a revolving magnetic field. The stator encircles a cylindrical rotor carrying the secondary winding in slots on its outer periphery. The rotor winding may be one of two types: squirrel-

cage and slip-ring for wound-rotor). In a squirrel-cage machine the rotor winding forms a complete closed circuit in itself. The rotor winding of a slip-ring machine is completed when the slip rings are connected either directly together or through some resistance external to the machine. The rotor shaft is coupled to the shaft of the driven mechanism.

The rotor is stationary at some instant of time. The revolving magnetic field of the stator winding cuts across the stationary rotor winding at synchronous speed and induces an e. m. f. in it. The e. m. f. will give rise to a current which sets up a magnetic field. The rotor starts rotating.

It is the interaction between the rotor current and the revolving magnetic field that has created torque and has caused the rotor to rotate in the same direction as the revolving magnetic field. Tine speed of the rotor is 98–95 per cent of the synchronous speed of the revolving magnetic field of the stator.

Hence another name for this type of motor is the asynchronous motor. As a matter of fact, the speed of the rotor cannot be equal to synchronous speed. If it were equal to the latter, the revolving magnetic field would not be able to cut the secondary conductors and there would not be any current induced in the secondary winding and no interaction between the revolving field and the rotor current, and the motor would not run.

14.2 Translate the sentences, paying attention to the translation of the word -one-:

1. One should distinguish between single-phase and three-phase induction motors.
2. The new device is better the old one.
3. The three-phase induction motor type is the most commonly used one.
4. The rotor winding may be one of two types.
5. As a matter of fact the speed of the rotor cannot be equal to synchronous one.

14.3 Translate the sentences from the text paying attention to the Participle Constructions:

1. In the split-phase method an auxiliary stator winding is provided for starting purposes only, this winding being displaced from the main stator winding by 90 electrical degrees.

2. The starting torque of such motions being limited, they are frequently constructed with the rotor arranged to revolve freely on the shaft at starting until nearly normal speed is reached.

3. An auxiliary winding may be connected to the single-phase line through an external inductance and a switch, the introduction of the inductance in the auxiliary winding splitting the phase as before.

14.4 Answer the following questions:

1. What way does the single-phase motor differ from the three-phase one?
2. What is the starting of single-phase induction motors accomplished by?
3. How can an auxiliary winding be connected to the single-phase line?
4. What parts does an induction motor consist of?
5. What are the two types of the rotor winding?

14.5 Work out the plan of the text.

14.6 State 5 questions to the text.

UNIT 15

15.1 Read the text and do the tasks below:

TRANSFORMERS

One of the great advantages in the use of the alternating current is the ease with which the voltage may be changed by means of a relatively simple device known as a transformer. Although there are many different types of transformers and a great variety of different applications, the principles of action are the same in each case.

The transformer is a device for changing the electric current from one voltage to another. It is used for increasing or decreasing voltage. So the function of a

transformer is to change voltage and current of an alternating system to meet requirements of the equipment used. It is known to be simple in elementary principle, and in construction that is it involves no moving parts.

Transformers change voltage through electromagnetic induction.

The principle parts of a transformer are: an iron core and, usually, two coils of insulated windings. One of them is called primary, another is called the secondary. The primary coil is connected to the source of power. The secondary coil is connected to the load. Thus, the primary is the coil to which power is supplied. The secondary is the coil from which power is taken. In scientific terms to produce an alternating magnetic flux in the iron core an alternating current must be passed through the primary coil. This flux is considered to induce electromotive force in both primary and secondary coils. The secondary coil is open – circuited. Current flows in the secondary coil when the latter is connected to the external circuit or load. The flow of current in the secondary coil tends to reduce the flux in the core. Transformers are placed inside a steel tank usually with oil to improve the insulation and also to cool the device.

15.2 Guess the meaning of the following international words:

1) transformer; 2) type; 3) principle; 4) electric; 5) function; 6) elementary; 7) construction; 8) induction.

15.3 Translate into Ukrainian the words and expressions from the text:

1) advantage; 2) voltage; 3) relatively simple; 4) application; 5) increase; 6) to decrease; 7) to meet requirements; 8) moving parts; 9) iron core; 10) insulated windings; 11) load; 12) electromotive force; 13) to induce.

15.4 Give the English equivalents to the words below:

1) змінний струм; 2) прилад; 3) принцип роботи (дії); 4) електромагнітна індукція; 5) котушка; 6) первинна (вторинна) обмотка; 7) джерело живлення; 8) магнітний потік; 9) сталевий контейнер; 10) остуджувати.

15.5 State questions to the underlined words:

1. Voltage may be changed by *a transformer*.
2. *Transformers* change voltage through electromagnetic induction.
3. Transformer is used for *increasing or decreasing voltage*.
4. The *primary winding* is connected to the source of power.
5. Transformers are placed inside *a steel tank*.

15.6 Answer the questions:

1. What kind of device is a transformer?
2. What are the functions of a transformer?
3. What are the principle parts of a transformer?
4. What is the primary coil connected to?
5. What is the secondary coil connected to?
6. What are the principles of action of a transformer?
7. Where are the transformers placed?

15.7 Topics for discussion:

1. Transformer as an electric device.
2. Main parts and principles of a transformer action.

UNIT 16

16.1 Read the text and do the tasks below:

TYPES OF TRANSFORMERS

There are different types of transformers. By the purpose they are classified into step-up transformers and step-down transformers. In a step-up transformer the output voltage is larger than the input voltage, because the number of turns on the secondary winding is greater than that of the primary. In a step down transformer the output

voltage is less than input voltage as the number of turns on the secondary is fewer than that on the primary.

By the construction transformers are classified into core-type and shell type transformers. In the core-type transformers the primary and the secondary coils surround the core. In the shell type transformers the iron core surrounds the coils. Electrically they are equivalent. The difference is in the mechanical construction.

By the methods of cooling transformers are classified into air – cooled, oil – cooled and water – cooled transformers.

By the number of phases transformers are divided into single – phase and polyphase transformers.

Instrument transformers are of two types, current and potential.

A current transformer is an instrument transformer used for the transformation of a current at a high voltage into proportionate current at a low voltage.

Current transformers are used in conjunction with a.-c. meters or instruments where the current to be measured must be of low value. They are also used where high – voltage current has to be metered. A voltage transformer, which is also called a potential transformer, may be defined as an instrument transformer for the transformation of voltage from one value to another. This transformer is usually of a step – down type because it is used when a meter is installed for use on a high – voltage system.

Transformers operate equally well to increase the voltage and to reduce it.

The above process needs a negligible quantity of power.

Transformers are widely used in our everyday life. All radio – sets and all television sets are known to use two or more kinds of transformers. These are familiar examples showing that electronic equipment cannot do without transformers.

16.2 Guess the meaning of the following international words:

1) to classify; 2) method; 3) phase; 4) instrument; 5) system; 6) process; 7) radio; 8) television.

16.3 Give the English equivalents for the words below:

1) мета; 2) трансформатор; 3) вихідна / вхідна напруга; 4) число витків; 5) механічний пристрій; 6) монофазні / поліфазні трансформатори; 7) висока / низька напруга; 8) визначати; 9) працювати; 10) незначна кількість.

16.4 Translate into Ukrainian the words and expression from the text:

1) core-type / shell-type transformers; 2) air-cooled / oil-cooled / water-cooled transformers; 3) current / potential transformers; 4) in conjunction with smth.; 5) to reduce; 6) electronic equipment.

16.5 Complete the sentences, using the text:

1. By the purpose transformers are …
2. By the construction transformers are …
3. By the methods of cooling transformers are …
4. By the number of phases transformers are …
5. Transformers operate equally well…
6. Process of voltage changing needs…
7. Familiar examples of transformer applications are …

16.6 Answer the questions:

1. What voltage is larger in a step-up transformer and why?
2. What voltage is less in a step-down transformer and why?
3. What is the construction of a core-type transformer?
4. What is the construction of a shell-type transformer?
5. What are the two types of instrument transformers?
6. What are current transformers used for?
7. What are potential transformers used for?

16.7 Topics for discussion:

1. Types of transformers.

2. Use of transformers in everyday life.

UNIT 17

17.1 Read the text and do the tasks below:

MEASUREMENTS OF ELECTRIC VALUES

The measurement of any physical quantity applies a determination of its magnitude in terms of some appropriate unit. In the case of simple fundamental quantities such as length, mass or time, the units themselves are simple.

Electrical and magnetic quantities are, however, much less simple than length, mass or time and cannot be measured directly by comparison with a material stand. The units in which these quantities are expressed have to be defined in terms of their observable affects obtained in experimental work, e.g. the weight of silver deposited in one second by a current when it is passed through a solution of silver nitrate is a measure of the magnitude of this current.

Electrical measurements can be classified broadly as neither absolute measurements, nor secondary measurements, but the first class of such measurements is rarely undertaken.

17.2 Guess the meaning of the following international words:

1) physical; 2) system; 3) fundamental; 4) material; 5) experimental; 6) absolute; 7) class.

17.3 Give the English equivalents to the words below:

1) вимір; 2) визначення; 3) відповідна одиниця; 4) бути відповідним; 5) порівняння; 6) досягати; 7) срібло; 8) широко; 9) дбати; 10) довжина.

17.4 Translate into Ukrainian the words and expressions from the text:

1) magnitude; 2) electrical and magnetic quantities; 3) to define; 4) observable affects; 5) to deposit; 6) secondary measurements; 7) to undertake.

17.5 Insert the words:

1. Magnitude of any … (фізична величина) must be determined in terms of some appropriate … (одиниця).

2. … (одиниці) are simple for simple … (основних) quantities.

3. … (електричні) and (магнітні) quantities cannot be measured simply.

4. These units must be … (визначені) in terms of their … (за якими спостерігають) effects obtained in… (експериментальна робота).

5. Absolute … (виміри) are … (рідко) undertaken.

17.6 Answer the questions:

1. What do we need to measure any physical quantity?

2. What simple units for measuring of simple fundamental quantities do you know?

3. Can electrical and magnetic quantities be measured directly by comparison with a material stand?

4. How can we get units for defining electrical and magnetic quantities?

5. What types of measurement do you know?

17.7 State questions to the underlined words:

1. Before we can measure, we must decide upon *a system of units*.

2. *Electric and magnetic quantities* are much less simple than fundamental quantities.

3. These quantities cannot be measured directly *by comparison with a material stand*.

4. Electrical measurements can be classified as neither absolute, nor secondary measurements. (Question-tag)

17.8 Topics for discussion:

1. Measurement of any physical quantity.

2. Measurement of electric and magnetic quantities.

UNIT 18

18.1 Read the text and do the tasks below:

MAIN TYPES OF AMMETERS AND VOLTMETERS

Ammeters and voltmeters are made to operate on the same principle. The two principle kinds are the moving coil and moving iron types.

The electro-magnetic effect of the current is the one chiefly made use of for measuring purposes. Moving iron instruments employ this effect. The moving- iron instrument consists of a fixed coil of wire carrying the current which magnetizes a small piece of soft iron mounted on the instrument spindle. In construction there are two varieties: the repulsion type having two pieces of iron; and the attraction type having only one.

In the attraction type of the instrument the bobbin carrying the wire is oblong instead of circular, and has only a narrow slot-shaped opening in the center.

A thin flat piece of iron, which is mounted on the instrument spindle, is sucked into this opening by magnetic attraction when the current flows. Either gravity or spring control can be used on moving-iron instruments and damping is usually by means of an air-dash-pot.

A moving-coil instrument may be compared to a miniature direct-current motor in which the armature never moves more than about a quarter of a revolution.

When a current flows through the coil of a moving-coil type ammeter, it becomes a magnet, one face being of north, and the other of south polarity.

These poles are attracted by the poles of opposite polarity of the permanent magnet, and the coil tends to turn until its axis is parallel with the line joining the pole pieces of the permanent magnet. This movement is proportional to the current flowing and is opposed by the control springs. A pointer fixed to the coils moves over a graduated scale and indicates the current flowing in amperes. The scale of this type of instrument is evenly divided, but the positive terminal must be connected to the positive terminal of the supply or the instrument tends to read backward. Such an instrument is only suitable for d. c. circuits.

Moving-coil instruments are more accurate and sensitive, but more expensive than those of moving-iron types.

18.2 Give the English equivalents for the following words and word combinations:

1) електромагнітний тип; 2) магнітно-електричний тип; 3) вісь; 4) репульсіонний тип; 5) тип, що притягує; 6) довгастий; 7) встановлювати; 8) втягувати.

18.3 Translate into Ukrainian:

1) purpose; 2) employ; 3) slot-shaped; 4) magnetic attraction; 5) damp; 6) revolution; 7) pole; 8) axis; 9) pointer; 10) graduated scale.

18.4 Answer the questions:

1. What are the two principle kinds of ammeters and voltmeters?
2. What is the construction of a moving iron instrument?
3. What are the two types of moving iron instrument?
4. How does a moving coil instrument work?
5. What instrument is suitable only for d.c.?
6. What instruments are more expensive and sensitive: moving coil or moving iron instruments?

18.5 Insert the words:

1. In the attraction type of the … (механізми) the bobbing is … (продовгуватий) instead of … (круглий).
2. A small piece of … (залізо) is mounted on the instrument … (вісь).
3. … (Амортизація) is usually by means of an … (повітряний заспокоювач).
4. The … (якір) never moves more than about a quarter of a … (повний оберт) in a miniature d. c. motor.
5. … (котушковий) movement is proportional to … (рух струму) and is opposed by the … (пружинний механізм).

6. … (Стрілка) indicates the … (напруга) flowing in … (ампер).

7. The positive terminal must be connected to the positive terminal of the … (живлення) or the … (механізм) tends to read … (навпаки).

18.6 Topics for discussion:

1. Moving iron instruments.
2. Moving coil instruments.

UNIT 19

19.1 Read the text and do the tasks below:

ELECTRICAL MEASURING INSTRUMENTS AND UNITS

Any instrument which measures electrical values is called a meter. An ammeter measures the current in amperes. The abbreviation for the ampere is amp. A voltmeter measures the voltage and the potential difference in volts.

The current in a conductor is determined by two things – the voltage across the conductor and the resistance of the conductor. The unit by which resistance is measured is called the ohm. The resistance in practice is measured with the ohm-meter. A wattmeter measures electrical power in watts. Very delicate ammeters are often used for measuring very small currents. A meter whose scale is calibrated to read a thousandth of an ampere is called a micro ammeter or galvanometer.

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. 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. In order that the connection of the voltmeter to the circuit does not change tire electric current in the

circuit, the voltmeter must have high resistance. If the armature coil does not have large resistance of its own, additional resistance is added in series.

The heating effect, electrostatic effect, magnetic and electromagnetic effects of electric current are used in order to produce the defleting torque. The resulting measuring instruments are called: (a) hot wire, (b) electrostatic, (c) moving iron, (d) moving coil, and (e) induction. Various types are used with both d. c. and a. c., but the permanent-magnet moving coil instrument are used only with d. c., and the induction type instruments are limited to a. c.

All, except the electrostatic type instruments, are current measuring devices, fundamentally ammeters. Consequently, most voltmeters are ammeters designed also to measure small values of current directly proportional to voltage to be measured.

19.2 Guess the meaning of international words:

1) instrument; 2) fact; 3) abbreviation; 4) voltmeter; 5) ohm; 6) ohmmeter; 7) wattmeter; 8) galvanometer; 9) shunt.

19.3 Give the Ukrainian equivalents to the words below:

1) resistance; 2) to offer; 3) scale; 4) to prevent; 5) armature; 6) connection; 7) heating effect.

19.4 Give the English equivalents to the words and word-combinations:

1) амперметр; 2) різниця потенціалів; 3) визначати; 4) чутливий; 5) градувати; 6) вставка; 7) котушка; 8) змінний струм (другий термін).

19.5 Answer the questions:

1. How are electrical values measuring instruments called?
2. How must the ammeter and the voltmeter be connected?
3. What resistance must the ammeter and the voltmeter have?
4. What resulting measuring instruments do you know?
5. What types of instruments are used with both d. c. and a. c.?

6. What instruments are used only with d. c. and limited to a. c.?

19.6 Describe different types of measuring instruments.

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Додатки

Додаток А - Glossary of Common Electrical Terms

A

Adapter – A cord or block style device with different ends that allows different devices to connect.

AC – Alternating Current. Electric current in which the flow of electric charge periodically reverses direction, whereas in direct current (**DC**, also **dc**), the flow of electric charge is only in one direction. The abbreviations *AC* and *DC* are often used to mean simply *alternating* and *direct*, as when they modify *current* or *voltage*. **AC** is the form in which electric power is delivered to businesses and residences.

Amperage – Amps/Amperes/Ampacity/Rated Amperage -measurement of the flow rate of electricity. If you think in terms of water through a hose, amperage would be a measure of water volume flowing through the hose.

AWG – American Wire Gauge; standard measuring gauge for non-ferrous conductors (i.e., non-iron and non-steal). Lower gauge numbers indicate larger conductor size.

C

Cable – A cable is a set of wires, usually encased in an outer protective jacket. A "cord" would be a cable by this definition so far, but a cable is part of a permanent installation; a cord is more flexible and often has a plug end for a portable appliance or lamp.

Cable Harness – A string of cables and/or wires which transmit informational signals or operating currents (energy). The cables are bound together by clamps, cable ties, cable lacing, sleeves, electrical tape, conduit, a weave of extruded string, or a combination thereof.

CE – Conformite Europeene. A European standard of safety. The CE marking on end products indicates compliance with all applicable directives. Further Reading Sample CE Compliance Mark

Conductor – The internal material of a cord that conducts electricity. Copper is the most common material used for electrical wiring. Silver is the best conductor, but is expensive. Because it does not corrode, gold is used for high-quality surface-to-surface contacts.

Connector – A female cord mounted wiring device with the conducting elements recessed behind the mating surface. This type of device is normally wired to be live when nothing is plugged in to it. Therefore, connectors are wired to the source of power.

CSA – Canadian Standards Association, a Canadian product safety and certification organization. Their registered mark shows that a product has been independently tested and certified to meet recognized standards for safety or performance. Further Reading

Sample CSA Compliance Mark

Current – The rate of flow of electrical energy through a conductor or wire, comparable to the amount of water flowing in a pipe. Electric current is measured in amperes or "amps".

D

Dielectric – Any insulating medium, which intervenes between two conductors and permits electrostatic attraction and repulsion to take place across it.

Dielectric Test – Tests which consist of the application of a voltage higher than that of the rated voltage for a specified time for the purpose of determining the adequacy against breakdown of insulating materials and spacing under normal conditions.

DC – Direct Current. Current which moves in a single direction in a steady flow. Normal household electricity is alternating current (AC) which repeatedly reverses its direction. However, many electronics devices require DC, and therefore must convert the current into DC before using it.

F

Ferrite – Ferrimagnetic ceramic non-conductive compound material used to prevent high frequency electrical noise from entering or exiting the equipment.

Fuse – A safety device consisting of a strip of wire that melts and breaks an electric circuit if the current exceeds a safe level.

G

GFCI – Ground-Fault Circuit-Interrupter. An electrical wiring device that disconnects a circuit whenever it detects that the electric current is not balanced between the energized conductor and the return neutral conductor. Such an imbalance is sometimes caused by current leakage through the body of a person who is grounded and accidentally touching the energized part of the circuit.

Ground – A connection between an electrical device and the Earth or at the voltage defined as zero (in the U.S., called ground; in the UK, called earth).

H

Harmonized Code – An international coding system for specifying the attributes of cord voltages, jackets, diameters, etc.

Hertz – Measurement of frequency, equaling one cycle per second, U.S. devices are typically 60 Hertz and international devices are typically 50 hertz.

I

ICC – International Color Code. Standard for wire jacket colors; Hot=Brown, Neutral=Blue, Ground=Green/Yellow.

IEC – International Electrotechnical Commission, an international organization that sets standards for electrical products

IEC320 – IEC standard of thirteen 2 or 3 wire plugs, connectors, inlets or outlets usually used in the computer industry.

Inlet – A male flange mounted wiring device with the conducting pins protruding and exposed. This type device should never be wired to make the exposed pins live while the mating device is unplugged.

Insulation – The material that encases a conductor preventing leakage of current from a conductor.

IP Rating – Ingress Protection Rating, a two digit code, and an optional letter, specifying the level of protection from foreign objects with the first digit referring to protection from solids and the second digit referring to protection from liquids. The optional letter can be appended to classify only the level of protection against access to hazardous parts by persons or to provide additional information related to the protection of the device.

J

Jacket – Outer material layer of a cord.

M

Midget – Referring to an inlet or outlet with a shallow depth. Commonly mounted in areas where space is limited.

N

NACC – North American Color Code; Hot=Black, Neutral=White, Ground=Green.

NEMA – National Electrical Manufacturers Association, an organization based in the U.S. that sets many common standards used in electrical products.

O

OD – Outer Diameter, the outer diameter of a cord.

OEM – Original Equipment Manufacturer.

P

Pigtail – A very short patch cable or wiring adapter. Primarily used in the automotive industries where a longer cable assembly is not needed.

Pin and Sleeve – Common term in reference to an IEC60309 device Outbound Link.

Plug – A male cord mounted wiring device with the conducting pins protruding and exposed. This type device should never be wired to make the exposed pins live while unplugged. Therefore, plugs are always dead until they are plugged into a power source such as a wall outlet or generator outlet.

Polarized – A plug and connector formed in a way that only allows proper connection.

R

Receptacle – A female flange mounted wiring device with the conducting elements recessed behind the mating surface. Often referred to as an outlet. This type of device is normally wired to be live when nothing is plugged in to it. Therefore, receptacles are wired to the source of power.

RoHS – Restriction of Hazardous Substances, a European directive dictating materials that may not be used in the manufacture of certain products. Materials restricted include: Lead, Mercury, Cadmium, Hexavalent Chromium, Polybrominated Byphenyls, and Plybrominated Diphenyl Ether.

ROJ – The designation to Remove Outer Jacket.

S

Slitting – The designation to separate insulated parallel wires.

Straight Blade – Refers to a NEMA device with straight prongs.

Stripping – The designation of the removal of the insulation or jacket from a conductor/wire.

T

Temperature Rating – The maximum temperature at which insulation will maintain its integrity.

Terminal – A terminal is the point at which a conductor from an electrical component, device or network comes to an end and provides a point of connection to external circuits. A terminal may simply be the end of a wire or it may be fitted with a connector or fastener. The connection may be temporary, as for portable equipment, or may require a tool for assembly and removal, or may be a permanent electrical joint between two wires or devices.

Twist-Locking – Refers to a NEMA device with circular prongs that locks the connection in place. Locking connectors use curved blades. Once pushed into the receptacle, the plug is twisted and its now-rotated blades latch into the receptacle. To unlatch the plug, the rotation is reversed. The locking coupling makes for a more reliable connection in commercial and industrial settings, where vibration or incidental impact could disconnect a non-locking connector.

U

UL – Underwriters Laboratories, an independent non-profit product safety and certification organization.

V

Voltage – The force or "push" driving electrical energy through a conductor or wire that can be compared to the pressure of water in a pipe.

W

Watt – A unit of power, defined as one joule per second. Wattage is calculated as Voltage x Amperage.

Wire Harness – See: cable harness. Also known as Wiring Assembly and Wiring Loom.