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ИНОСТРАННЫЙ ЯЗЫК

ЭЛЕКТРОЭНЕРГЕТИКА И ЭЛЕКТРОТЕХНИКА

Методические указания для самостоятельной работы для студентов специальности 13.03.02

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Методические указания предназначены для студентов, обучающихся по специальности 13.03.02 «Электроэнергетика и электротехника», всех направленностей и согласованы с программой по иностранному языку для студентов неязыковых вузов.

Предлагаемый материал направлен на совершенствование навыков профессионально-ориентированного чтения на английском языке. Данные методические указания содержат тексты научно-технического характера по энергетике и комплекс заданий с учетом профессиональных интересов обучаемых. Предназначены для самостоятельной работы.

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ПРЕДИСЛОВИЕ

Данные методические указания предназначены для учебно-методического сопровождения курса английского языка для студентов неязыковых вузов, обучающихся по специальности 13.03.02 «Электроэнергетика и электротехника» всех направленностей.

Методические указания содержат тексты научно-технического характера по энергетике и комплекс заданий с учетом профессиональных интересов обучаемых и соблюдением принципа междисциплинарности обучения. Изучение предложенного материала направлено на развитие умений просмотрового и изучающего чтения текстов по направлению подготовки, а также их перевода на русский язык с последующим использованием полученной информации для речевой практики; совершенствование навыков и умений всех видов чтения (изучающего, ознакомительного, поискового и просмотрового) и перевода специальной научно-технической литературы для извлечения информации, ознакомление с узкоспециализированной терминологией на английском языке.

Методические указания состоят из 6 разделов, включающих разное количество текстов по энергетике и электротехнике, а также для работы предлагаются разнообразные виды упражнений. Предложенные материалы предназначены для самостоятельной работы.

I. HISTORY OF ELECTRICITY

1. Study the following words and word constructions.

to give vent to smth	давать выход чему-либо
to set the ball rolling	начать новую страницу
to credit smb with smth	называть кого-либо кем-либо
to dawn on smb	осенять кого-либо
to win a day	одержать победу
on the spur of the	экспромтом
to become all the rage	стать очень модными
voltaic pile	гальваническая батарея
now and then	время от времени
to begin to tackle smth	взяться за решение чего-либо
with the systematic energy	со всей серьёзностью
to slump	упасть в цене
to stake smth	рискнуть чем-либо
to throw a switch	включить рубильник
to come to stay	получить признание
squirrel-cage motor	короткозамкнутый двигатель
a great deal	значительно
to have smb's eyes on smth	обратиться к чему-либо
to be very much "in the air"	давно витать в воздухе
to appeal most	нравиться больше всего
bucket-shaped blade	ковшеобразная лопасть

by overhead cable	по воздушному кабелю
to step down	понижаться
diehard	консерватор
a good deal of justification	большие основания
to catch on	привиться
to gain ground	шагнуть вперёд
by no means	ни в коей мере
to outstay welcome	устаревать
as long ago as	ещё в какое-либо время
to work "cold"	не нагреваться во время работы
would-be	мечтающий сделать что-либо
to raise funds	извлечь выгоду

2. Read and translate the text below.

EARLY DAYS OF ELECTRICITY

There is electricity everywhere in the world. It is present in the atom, whose particles are held together by its forces; it reaches us from the most distant parts of the universe in the form of electromagnetic waves. Yet we have no organs that could recognize it as we see light, hear sound. We have to make it visible, tangible or audible; we have to make it perform work to become aware of its presence. There is only one natural phenomenon which demonstrates it unmistakably to our senses of seeing and hearing – thunder and lightning; but we recognize only the effects – not the force which causes them.

Small wonder, then, that Man lived for ages on this earth without knowing anything about electricity. He tried to explain the phenomenon of the thunderstorm to himself by imagining that some gods or other supernatural creatures were giving vent to their heavenly anger, or were fighting battles in the sky. Thunderstorms frightened our primitive ancestors; they should have been grateful to them instead because lightning gave them their first fires, and thus opened to them the road to civilization. It is a fascinating question how differently life on earth would have developed if we had an organ for electricity.

We cannot blame the ancient Greeks for failing to recognize that the force which causes a thunderstorm is the same which they observed when rubbing a piece of amber: it attracted straw, feathers, and other light materials. Thales of Miletus, the Greek philosopher who lived about 600 BC, was the first who noticed this. The Greek word for amber is "electron", and therefore Thales called that mysterious force electric. For a long time, it was thought to be of the same nature as the magnetic power of the lodestone since the effect of attraction seems similar, and in fact there are many links between electricity and magnetism.

There is just a chance, although a somewhat remote one, that the ancient Jews knew something of the secret of electricity. Perhaps the Israelites did know something about electricity; this theory is supported by the fact that the Temple at Jerusalem had metal rods on the roof which must have acted as lightning-conductors. In fact, during the thousand years of its existence it was never struck by lightning although thunderstorms abound in Palestine.

There is no other evidence that electricity was put to any use at all in antiquity, except that the Greek women decorated their spinning-wheels with pieces of amber: as the woolen threads rubbed against the amber it first attracted and then repelled them – a pretty little spectacle which relieved the boredom of spinning.

More than two thousand years passed after Thales's discovery without any research work being done in this field. It was Dr. William Gilbert, Elizabeth the First's physician-in-ordinary, who set the ball rolling. He experimented with amber and lodestone and found the essential difference between electric and magnetic attraction. For substances which behaved like amber – such as glass, sculpture, and sealing wax – he coined the term "electrica", and for the phenomenon as such the word "electricity". In his famous work "De magnete", published in 1666, he gave an account of his studies. Although some sources credit him with the invention of the first electric machine, this was a later achievement by Otto von Guericke, inventor of the air pump. Von Guericke's electric machine consisted of large, disc spinning between brushes; this made sparks leap across a gap between two metal balls. It became a favorite toy in polite society but nothing more than that. In 1700, an Englishman by the name of Francis Hawksbee produced the first electric light: he exhausted a glass bulb by means of a vacuum pump and rotated it at high speed while rubbing it with his hand until it emitted faint glow of light.

A major advance was the invention of the first electrical condenser, now called the Leyden jar, by a Dutch scientist, a water-filled glass bottle coated inside and out with metallic surfaces, separated by the non-conducting glass; a metal rod with a knob at the top reached down into the water. When charged by an electric machine it stored enough electricity to give anyone who touched the knob a powerful shock. More and more scientists took up electric research. A Russian scientist Professor Reichmann from St. Petersburg was killed when he worked on the same problem.

Benjamin Franklin, born in Boston, was the fifteenth child of poor soap-boiler from England. He was well over 30 when he looked up the study of natural phenomena. "We had for some time been of opinion, that the electrical fire was not created by friction, but collected, being really an element diffused among, and attracted by other matter, particularly by water and metals", – wrote Franklin in 1747. Here was at last a plausible theory of the nature of electricity, namely, that it was some kind of "fluid". It dawned on him, that thunderstorms were merely a discharge of electricity between two objects with different.

He saw that the discharging spark, the lightning, tended to strike high buildings and trees, which gave him an idea of trying to attract the electrical “fluid” deliberately to the earth in a way that the discharge would do no harm.

In order to work this idea out he undertook his famous kite-and-key experiment in the summer of 1755. It was much more dangerous than he realized. During the approach of thunderstorm he sent up a silken kite with an iron tip; he rubbed the end of the kite string, which he had soaked in water to make it a good conductor of electricity, with a large iron key until sparks sprang from the string – which proved his theory. Had the lightning struck his kite he, and his small son whom he had taken along, might have lost their lives.

On the next experiment he fixed an iron bar to the outer wall of his house, and through it charged a Leyden jar with atmospheric electricity. Soon after this he was appointed Postmaster General of Britain’s American colonies, and had to interrupt his research work. Taking it up again in 1760, he put up the first effective lightning conductor on the house of a Philadelphia businessman.

His theory was that during a thunderstorm a continual radiation of electricity from the earth through the metal of the lightning-conductor would take place, thus equalizing the different potentials of the air and the earth so that the violent discharge of the lightning would be avoided. The modern theory, however, is that the lightning-conductor simply offers to the electric tension a path of low resistance for quiet neutralization. At any rate – even if Franklin’s theory was wrong – his invention worked.

Yet its general introduction in America and Europe was delayed by all kinds of superstitions and objections: if God warned to punish someone by making the lightning strike his house, how could Man dare to interfere? By 1782, however, all the public buildings in Philadelphia, first capital of the USA, had been equipped with Franklin lightning-conductors, except the French Embassy. In that year this house was struck by lightning and an official killed. Franklin had won the day.

It was he who introduced the idea of "positive" and "negative" electricity, based on the attraction and repulsion of electrified objects. A French physicist, Charles Augustin de Coulomb, studied these forces between charged objects, which are proportional to the charge and the distance between the objects; he invented the torsion balance for measuring the force of electric and magnetic attraction. In his honor, the practical unit of quantity of electricity was named after him.

To scientists and laymen alike, however, this phenomenon of action at a distance caused by electric and magnetic forces was still rather mysterious. What was it really? In 1780, one of the greatest scientific fallacies of all times seemed to provide the answer. Aloisio Galvani, professor of medicine at Bologna, was lecturing to his students at his home while his wife was skinning frogs, the professor's favorite dish, for dinner with his scalpel in the adjoining kitchen. As she listened to the lecture the scalpel fell from her hand on to the frog's thigh, touching the zinc plate at the same time. The dead frog jerked violently as though trying to jump off the plate. The signora screamed. The professor, very indignant about this interruption of his lecture, strode into the kitchen. His wife told him what had happened, and again let the scalpel drop on the frog. Again, it twitched.

No doubt the professor was as much perplexed by this occurrence as his wife. But there were his students, anxious to know what it was all about. Galvani could not admit that he was unable to explain the jerking frog. So, probably on the spur of the moment he explained: "I have made a great discovery – animal electricity, the primary source of life".

"An intelligent woman had made an interesting observation, but the not-so-intelligent husband drew the wrong conclusions, was the judgment of a scientific author a few years later. Galvani made numerous and unsystematic experiments with frogs' thighs, most of which failed to prove anything at all; in fact, the professor did not know what to look for, except his animal electricity. These experiments became all the rage in Italian society, and everybody talked about galvanic electricity currents – terms which are still in use although Professor Galvani certainly did not deserve the honor.

A greater scientist than he, Alessandro Volta of Pavia, solved the mystery and found the right explanation for the jerking frogs. Far from being the "primary source of life", they played the very modest part of electric conductors while the steel of the scalpel and the zinc of the plate were, in fact, the important things. Volta showed that an electric current begins to flow when two different metals are separated by moisture (the frog had been soaked in salt water), and the frog's muscles had merely demonstrated the presence of the current by contracting under its influence.

Professor Volta went one step further – a most important step, because he invented the first electrical battery, the "Voltaic pile". He built it by using discs of different metals separated by layers of felt which he soaked in acid. A "pile" of these elements produced usable electric current, and for many decades this remained the only practical source of electricity. From 1800, when Volta announced his invention, electrical research became widespread among the world's scientists in innumerable laboratories.

II. PRINCIPLES OF ELECTRICITY

1. Recognize the following international words:

electrical, material, resistor, orbit, electron, atom, electronics, diode, transistor, laser, equivalent, potential, energy, voltage, analogous, battery, generator, ampere.

2. Memorize the words to be ready to read and speak about principles of electricity.

conductor	проводник
semiconductor	полупроводник
insulator	изолятор, диэлектрик
circuit	цепь, схема
current	ток
alternating current	переменный ток
direct current	постоянный ток
source	источник
to supply	снабжать, снабжение
property	свойство
velocity	скорость
potential difference	разность потенциалов
electromotive force	электродвижущая сила
to measure	измерять
charge	заряд
parallel connection	параллельное соединение
in series	последовательное соединение

3. Decode the following acronyms: e.m.f.; d.c.; a.c.; p.d.; V; A.

4. Read and translate the following words and word combinations: excellent, conductor, current flow, good insulator, semiconductor materials, electrical supply, potential difference, supply source, a measured electromotive force, charge carrier, electrical circuit, series connection, much higher velocity.

***5. Use the words and the word combinations from the exercises 2 and 4 in the following sentences*:**

1… include silicon, germanium and cadmium sulphide. 2. Battery is the simplest … 3. Electrons are negative … 4. Metal is a … 5. Electrical generator produces … 6. The electrical potential between two points in a circuit is known as the … 7. Two types of connections are known in electrical circuit: … and … 8. The voltage which produces the current is known as …

6. Read and translate the text.

VOLTAGE AND CURRENT

Voltage is the electrical equivalent of mechanical potential. If a person drops a rock from the first storey of a building, the velocity that the rock attains on reaching the ground is fairly small. However, if the rock is taken to the twentieth floor of the building, it has a much greater potential energy and, when it is dropped it reaches a much higher velocity on reaching the ground. The potential energy of an electrical supply is given by its voltage and the greater the voltage of the supply source, the greater its potential to produce electrical current in any given circuit connected to its terminals (this is analogous to the velocity of the rock in the mechanical case). Thus, the potential of a 240-volt supply to produce current is twenty times that of a 12-volt supply.

The electrical potential between two points in a circuit is known as the potential difference or p.d. between the points. A battery or electrical generator has the ability to produce current flow in a circuit, the voltage which produces the current being known as the electromotive force (e.m.f.). The term electromotive force strictly applies to the source of electrical energy, but is sometimes (incorrectly) confused with potential difference. Potential difference and e.m.f. are both measured in volts, symbol V.

The current in a circuit is due to the movement of charge carriers through the circuit. The charge carriers may be either electrons (negative charge carriers) or holes (positive charge carriers), or both. Unless stated to the contrary, we will assume conventional current flow in electrical circuit that is we assume that current is due to the movement of positive charge carriers (holes) which leave the positive terminal of the supply source and return to the negative terminal. The current in an electrical circuit is measured in amperes, symbol A, and is sometimes (incorrectly) referred to as "amps".

A simple electrical circuit comprises a battery of e.m.f. 10 V which is connected to a heater of fixed resistance; let us suppose that the current drawn by the heater is 1 A. If two 10-V batteries are connected in series with one another, the e.m.f. in the circuit is doubled at 20 V; the net result is that the current in the circuit is also doubled. If the e.m.f. is increased to 30 V, the current is increased to 3 A, and so on.

A graph showing the relationship between the e.m.f. in the circuit and the current is a straight line passing through the origin; that is, the current is zero when the supply voltage is zero. This relationship is summed up by Ohm's law.

7. Find the sentences in the text about: a) potential difference; b) charge carriers; c) measurements of potential difference and electromotive force; d) electrical equivalent of mechanical potential; e) conventional current flow; f) electromotive force; g) series connection.

III. TYPES OF ELECTRIC CURRENT

1. Read and translate the text.

An electric current may be produced in a variety of ways, and from a number of different types of apparatus, e.g., an accumulator, a d.c. or an a.c. generator, or a thermionic valve. Whatever the source of origin, the electric current is fundamentally the same in all cases, but the manner in which it varies with time may be very different. This is shown by the graph of the current plotted against time as a base, and a number of examples are illustrated in Fig. 1.

(a) represents a steady direct current (D.C.) of unvarying magnitude, such as is obtained from an accumulator.

(b) represents a D.C. obtained from a d.c. generator, and consists of a steady D.C. superimposed on which is a uniform ripple of relatively high frequency, due to the commutator of the d.c. generator. As the armature rotates the commutator segments come under the brush in rapid succession and produce a ripple in the voltage which is reproduced in the current.

(c) represents a pulsating current varying periodically between maximum and minimum limits. It may be produced by adding a D.C. to an A.C. or vice versa. The d.c. component must be the larger if the current is to remain unidirectional. All the first three types, of current are unidirectional, i.e., they flow in one direction only.

(d) represents a pure alternating current (A.C.). The current flows first in one direction and then in the other in a periodic manner, the time of each alternation being constant. In the ideal case the current varies with time according to a sine law, when it is said to be sinusoidal. Considering the time of a complete cycle of current (a positive half-wave plus a negative half-wave) as equal to 360°, the instantaneous values of the current are proportional to the sine of the angle measured from the zero point where the current is about to rise in the positive direction*.

(e) represents a type of A.C. with a different wave form. Such an A.C. is said to have a peaked wave form, the term being self-explanatory.

(f) represents an A.C. with yet another different wave form. Such an A.C. is said to have a flat-topped wave form, the term again being self-explanatory. Both this and the previous example represent cases of A.C. having non-sinusoidal wave forms (g) represents an example of an oscillating current, and is similar in shape to (d) except that it has a much higher frequency. An oscillating current is usually regarded as one having a frequency determined by the constants of the circuit, whereas an alternating current has a frequency determined by the apparatus supplying the circuit.

(h) represents another type of oscillating current which is known as damped. The current again has a constant frequency, but its amplitude is damped, i.e., it dies down, after which it is brought back to its original value.

(i) represents yet another type of oscillating current, this time known as a modulated current. The amplitude varies rhythmically between maximum and minimum values. It may even die down to zero.

(j) The next three examples represent various types of transient currents. These transient currents usually die away extremely rapidly, and times** are generally measured in microseconds. The first example shows a current dying away to zero, and is an example of a unidirectional transient. Theoretically it takes an infinite time to reach absolute zero.

(k) represents a simple a.c. transient. The current gradually dies down to zero as in the previous case, but this time it is an A.C. that is dying away.

(l) represents a peculiar, but not uncommon, type of a.c. transient. The current is initially unidirectional, but it gradually becomes an ordinary A.C. The positive halfwaves die away much more rapidly than the negative half-waves grow, so that the final amplitude is very much reduced.

The above examples do not represent all the types of current encountered, but they serve as illustrations of what may be expected. It will be observed that in all the above cases the current consists of either or both unidirectional and alternating components***. In modern electrical engineering alternating currents play a predominant part, so that knowledge of the a.c. circuit is of basic importance.

* where the current is about to rise in the positive direction где ток должен начать возрастать в положительном направлении; (to) be about to *собираться* (делать ч. л.)

** times зд. *периоды затухания*

*** in all the above cases the current consists of either or both unidirectional and alternating components во всех вышеуказанных случаях ток состоит или из тока одного направления, или из знаков переменного тока, или из того и другого вместе. Above в функции определения переводится «вышеуказанный, вышеупомянутый». Местоимение either здесь имеет значение *любой*, *один из двух*, но не *оба*

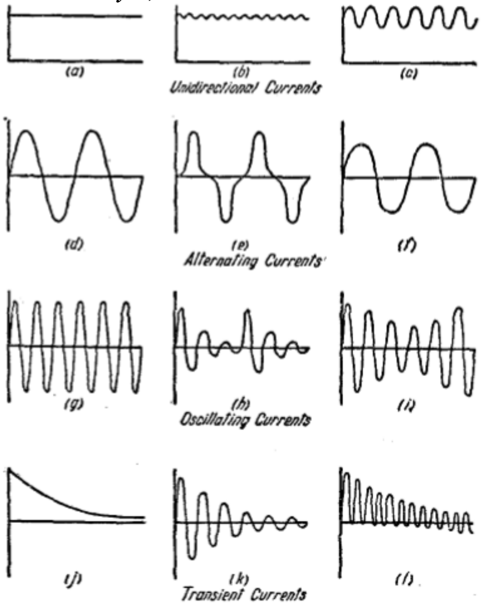

Fig. 1. Types of Electric Current.

IV. BATTERIES AND OTHER SOURCES OF E.M.F.

1. Recognize the following international words: chemical, effect, electric, industry, electrode, anode, cathode, electrolyte, material, battery, category, accumulator, limit, resistor, function, employ, construction, instrument, electrostatic, voltmeter, wattmeter.

2. Memorize the words to be ready to read and speak about batteries and other sources of e.m.f.

to electroplate	наносить покрытие гальваническим способом
cell (storage)	элемент (аккумуляторный)
plate	пластина, анод
to immerse	погружать
reverse	переключение, изменение полярности
resistor	сопротивление, реостат
magnitude	величина
thermocouple	термопара, термоэлемент
to pilot	центровать
bearing	подшипник, опора
taut	упругий
air-vane damping	пневматическое затухание
armature	сердечник, якорь
fuse	плавкий предохранитель
trip	механизм для авто выключения
slug	сердечник

to deflect	отклонять
to ensure	гарантировать
to wound	наматывать, виток

3. Read and translate the following word combinations:
electroplating industry; electrochemical effect; primary cell; secondary or storage cell; moist electrolyte; reversible chemical action; fixed resistor; variable resistor; analogue instruments; digital instruments; thermocouple instruments; a deflecting force; a controlling force; a damping force; permanent magnet; taut metal band; small section wire; iron armature; magnetic pull.

4. Use the word combinations given above in the following sentences.
1. All the … depend on the electrolyte. 2. … can be recharged. 3. A dry cell has a … 4. Rechargeable cells are often connected in series to form a … 5. When current is passed through cells of the battery in the reverse direction they have a … 6. There are two types of resistors: …, … and … 7. Instruments are classified as … and … 8. The effect of heat produced by a current in a conductor is used in … 9. The moving coil is situated in the magnetic field produced by a … 10. The "voltage" coil has many turns of …

5. Read and translate the text without a dictionary.

ELECTROCHEMICAL EFFECT

The chemical effect of an electric current is the basis of the electroplating industry; the flow of electric current between two electrodes (one being known as the anode and the other as the cathode) in a liquid (the electrolyte) causes material to be lost from one of the electrodes and deposited on the other.

The converse is true, that is, chemical action can produce an e.m.f. (for example, in an electric battery). All these electrochemical effects depend on the electrolyte. The majority of pure liquids are good insulators (for example, pure water is a good insulator), but liquids containing salts will conduct electricity. You should also note that some liquids such as mercury (which is a liquid metal) are good conductors.

6. Find in the text "Electrochemical effect" sentences about: a) the flow of electric current between two electrodes; b) liquids which are good conductors; c) liquids which are good insulators; d) electroplating industry; e) products of chemical action; f) dependence of electrochemical effects on the electrolytes.

7. Read the texts given below.

CELLS AND BATTERIES

A cell contains two plates immersed in an electrolyte, the resulting chemical action in the cell producing an e.m.f. between the plates. Cells can be grouped into two categories. A primary cell cannot be recharged and, after the cell is "spent" it must be discarded (this is because the chemical action inside the cell cannot be "reversed"). A secondary cell or storage cell can be recharged because the chemical action inside it is reversed when a "charging" current is passed through it.

Cells are also subdivided into "dry" cells and "wet" cells. A dry cell is one which has a moist electrolyte, allowing it to be used in any physical position (an electric torch cell is an example). A wet cell is one which has a liquid electrolyte which will spill if the cell is turned upside down (a cell in a conventional lead-acid auto battery is an example). There is, of course, a range of sealed rechargeable cells which are capable of being discharged or charged in any position; the electrolyte in these cells cannot be replaced.

A battery is an interconnected group of cells (usually connected in series) to provide either a higher voltage and/or a higher current than can be obtained from one cell.

STORAGE BATTERIES

Rechargeable cells are often connected in series to form a storage battery, a car battery being an example; a storage battery is frequently called an accumulator. The cells of the battery have a reversible chemical action and, when current is passed through them in the "reverse" direction (when compared with the discharging state); the original material of the electrodes is re-formed. This allows the battery to be repeatedly discharged and charged.

RESISTOR TYPES

A resistor is an element whose primary function is to limit the flow of electrical current in a circuit. A resistor is manufactured either in the form of a fixed resistor or a variable resistor, the resistance of the latter being alterable either manually or electrically. Many methods are employed for the construction of both fixed and variable resistors.

V. TYPES OF INSTRUMENTS

1. Read and translate the texts below. Prepare questions to be answered.

Instruments are classified as either analogue instruments or digital instruments. An analogue instrument is the one in which the magnitude of the measured electrical quantity is indicated by the movement of a pointer across the face of a scale. The indication on a digital instrument is in the form of a series of numbers displayed on a screen; the smallest change in the indicated quantity corresponding to a change of ˆ1 digit in the least significant digit (l.s.d.) of the number. That is, if the meter indicates 10.23 V, then the actual voltage lies in the range from 10.22 V to 10.24 V. Both types of instrument have their advantages and disadvantages, and the choice of the best instrument depends on the application you have in mind for it. As a rough guide to the features of the instruments, the following points are useful:

a) an analogue instrument does not (usually) need a battery or power supply;

b) a digital instrument needs a power supply (which may be a battery);

c) a digital instrument is generally more accurate than an analogue instrument (this can be a disadvantage in some cases because the displayed value continuously changes as the measured value changes by a very small amount);

d) both types are portable and can be carried round the home or factory.

A GALVANOMETER OR MOVING-COIL INSTRUMENT

A galvanometer or moving-coil instrument depends for its operation on the fact that a current-carrying conductor experiences a force when it is in a magnetic field. The “moving” part of the meter is a coil wound on an aluminium former or frame which is free to rotate around a cylindrical soft-iron core. The moving coil is situated in the magnetic field produced by a permanent magnet; the function of the soft-iron core is to ensure that the magnetic field is uniformly distributed. The soft-iron core is securely fixed between the poles of the permanent magnet by means of a bar of non-magnetic material.

The moving coil can be supported either on a spindle which is pivoted in bearings (often jewel bearings) or on a taut metal band (this is the so-called pivot less suspension). The current enters the “moving” coil from the terminal either via a spiral hairspring or via the taut band mentioned above. It is this hairspring (or taut band) which provides the controlling force of the instrument. The current leaves the moving coil either by another hairspring or by the taut band at the opposite end of the instrument.

When current flows in the coil, the reaction between each current-carrying conductor and the magnetic field produces a mechanical force on the conductor; this is the deflecting force of the meter.

This force causes the pointer to be deflected, and as it does so the movement is opposed by the hairspring which is used to carry current into the meter. The more the pointer deflects, the greater the controlling force produced by the hairspring.

Unless the moving system is damped, the pointer will overshoot the correct position; after this it swings back towards the correct position. Without damping, the oscillations about the correct position continue for some time. However, if the movement is correctly damped, the pointer has an initial overshoot of a few per cent and then very quickly settles to its correct indication. It is the aim of instrument designers to achieve this response.

Damping is obtained by extracting energy from the moving system as follows. In the moving-coil meter, the coil is wound on an aluminium former, and when the former moves in the magnetic field of the permanent magnet, a current (known as an eddy current) is induced in the aluminium former. This current causes power to be consumed in the resistance of the coil former, and the energy associated with it damps the movement of the meter.

REQUIREMENTS OF ANALOGUE INSTRUMENTS

Any instrument which depends on the movement of a pointer needs three forces to provide proper operation. These are:

a) a deflecting force;
b) a controlling force;
c) a damping force.

The deflecting force is the force which results in the movement or deflection of the pointer of the instrument. This could be, for example, the force acting on a current-carrying conductor which is situated in a magnetic field.

The controlling force opposes the deflecting force and ensures that the pointer gives the correct indication on the scale of the instrument. This could be, for example, a hairspring. The damping force ensures that the movement of the pointer is damped: that is, the damping force causes the pointer to settle down, that is, be "damped", to its final value without oscillation.

WATTMETERS

As the name of this instrument implies, its primary function is to measure the power consumed in an electrical circuit. The wattmeter described here is called an electrodynamic wattmeter or a dynamometer wattmeter. It has a pair of coils which are fixed to the frame of the meter (the fixed coils) which carry the main current in the circuit (and are referred to as the current coils), and a moving coil which is pivoted so that it can rotate within the fixed coils. The moving coil generally has a high resistance to which the supply voltage is connected and is called the voltage coil or potential coil. The pointer is secured to the spindle of the moving coil.

Dynamometer wattmeters can measure the power consumed in either a d.c. or an a.c. circuit.

Hairsprings are used to provide the controlling force in these meters, and air-vane damping is used to damp the movement. The power consumed by a three-phase circuit is given by the sum of the reading of two wattmeters using what is known as the two-wattmeter method of measuring power.

VI. PERSONAL PROTECTIVE EQUIPMENT

1. Read and translate the text.

Personal protective equipment (PPE), also known as personal protection wear, is any type of clothing or equipment worn by a person to protect them from some specific hazard. Typically, this is protection from any physical, radiological, electrical, chemical, biological, mechanical, or other threat in the workplace.

Types of Personal Protective Equipment

Workplaces are responsible for providing their employees with the proper types of personal protective equipment based on the specific hazards that exist in the facility. There are many types of PPE available to keep people safe. The following are some categories of personal protective equipment and the options within them.

Breathing Protection | Respirators

Respirators are a type of personal protective equipment designed specifically to protect the **lungs** of the people wearing them. They can help filter out dust, **debris**, chemicals, and many other potential dangers. There are many types of respirators used for PPE, including:

- ***Basic Facemask*** - A facemask can minimize the risk of **exposure** to simple biological contaminants, dust, debris, and other harmful **impurities** in the air. In a **pinch**, even a simple handkerchief could serve as a facemask (though not recommended for regular use).
- ***Filtered Respirator*** - If there are known impurities that can cause serious damage or illness, having a filter on the respirator is important. There are many types of filtered respirators available depending on how many impurities need to be removed.

- ***Self-Contained Breathing Apparatus*** - In situations where the air is extremely toxic, a self-contained breathing apparatus allows the employee to bring a supply of fresh air with them. This is also used when there is no oxygen to breath, such as under water.

Many chemicals and other materials can cause serious injuries or illnesses when they come in contact with the skin. When working with these hazards, having proper personal protective equipment is extremely important.

- ***Protective Clothing*** - The most common type of skin protection equipment is general protective clothing. Something as simple as a **lab coat** helps reduce the risk of getting splashed with potentially hazardous **solutions**. While it isn't a high level of protection, it is sufficient for many situations.
- ***Plastic Gloves*** - Plastic (or latex) gloves are among the most common types of skin protection equipment. They can keep a wide range of hazards away, including biological and chemical solutions.
- ***Cut-Resistant Gloves*** - Employees who work with sharp objects should wear cut-resistant gloves. These gloves are made of special materials that prevent blades from slicing through them.
- ***Heat-Resistant Clothing*** - When working with fire or other high temperature hazards, employees should wear heat-resistant clothing. This could be **heat-resistant** gloves or it could be an entire suit, depending on the situation.

- ***Electricity-Resistant Clothing*** - When working with or around high voltage areas, having PPE that can reduce the risk of electrical shock is essential. This could be rubber boots, gloves, or an entire body suit.
- ***Face Shields*** - Face shields reduce the risk of having something splash up into the face, causing damage. Whether working with hot items, corrosive materials, or biological materials, face shields can protect one of the most **vulnerable** parts of the body.
- ***Hard Hats*** - Hard hats are a great way to keep someone's head safe when working in an area where something could fall on it.

2. Translate the words in bold using a dictionary and try to explain them in English. Give their synonyms and make sentences with them.

3. Read and translate the following text.

Eye Protection

Protecting the eyes is extremely important because even a minor accident can cause long-term eye damage or even blindness. Here are several of the most common types of eye protection equipment:

- **Goggles** - Simple safety goggles provide a strong layer of protection to the eyes. This is good for preventing objects from flying into the eyes such as sawdust, stones, and shards of glass.
- **Welding Masks** - While welding masks sometimes cover the entire face, their main function is to protect the eyes from the extremely bright light of a torch. These masks are darkened significantly to prevent the light from reaching and damaging the eyes.

- **Sunglasses** - This is a simple type of PPE that most people never give a second thought. If you're regularly working in the sun or around bright lights, wearing sunglasses can help prevent many eye conditions down the road.

Hearing Protection

Protecting the hearing of employees is very important, but can be difficult. Many people don't notice when they are working around the constant noise of a factory or other workplace. While it may not be something people realize is happening, this can cause significant damage to the hearing over time. Wearing personal protective equipment for the ears is critical.

- **Ear Plugs** - Ear plugs are easy to use and provide a fair amount of protection by preventing loud noises from entering the ear at all.
- **Ear Muffs** - Ear muffs go over the entire ear, and when worn properly, can provide a significant amount of noise reduction.
- **Electronic Ear Muffs** - These advanced hearing protection devices work like ear muffs to stop the noise from coming in, but also have an electronic microphone that picks up voices and other noises and then plays them into the ear so people can still hear. The sounds are played at a low level so they do not cause damage.

There are different types of personal protective equipment for just about every situation. Figuring out what type is needed in a facility is a matter of evaluating the risks and determining what PPE can offer the needed protection.

4. Match the words (1-10) with their definitions (a-j). Translate the words using a dictionary, and then make up your own sentences using them.

1. goggles	a. broken pieces of something
2. sawdust	b. a liquid into which a solid has

	been mixed and has dissolved
3. voltage	c. a device worn over the mouth and nose to prevent harmful substances from being breathed in
4. debris	d. something that is dangerous and likely to cause damage
5. shards of glass	e. poisonous
6. solution	f. the fact of experiencing something or being affected by it because of being in a particular situation or place
7. respirator	g. special glasses that fit close to your face to protect your eyes
8. hazard	h. very small pieces of wood and powder that are produced when you cut wood with a saw
9. toxic	i. pieces of broken glass, cup, container, or similar object
10. exposure	j. the force of an electric current, measured in volts

5. Find 10 words connected with protective equipment hidden in the grid.

e	q	u	i	p	m	e	n	t	g
b	c	a	o	a	u	o	o	a	l
o	d	a	m	a	g	e	i	l	o
o	g	o	g	g	l	e	s	k	v
t	i	n	j	u	r	y	e	u	e
s	u	n	g	l	a	s	s	e	s
q	h	a	z	a	r	d	i	e	r
w	b	f	a	c	e	m	a	s	k
x	i	l	l	n	e	s	s	r	t

6. Match the left and the right.

1. welding mask	a. беруши
2. ear plugs	b. маска для защиты лица сварщика
3. ear muffs	c. значительный ущерб
4. noise reduction	d. защитная маска
5. significant damage	e. противошумные наушники
6. face shields	f. термостойкая одежда
7. heat-resistant clothing	g. поглощение/уменьшение шума
8. self-contained breathing apparatus	h. защитная каска
9. harmful impurities	i. вредные примеси
10. hard hats	j. противогаз с запасом кислорода

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CONTENTS