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МЕТОДИЧНІ ВКАЗІВКИ

до практичних занять з англійської мови
для студентів I курсу
спеціальності 141 «Електроенергетика, електротехніка та електромеханіка» денної форми навчання

«Measuring Systems in Electronics»

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UNIT I. MEASURING SYSTEMS IN ELECTRONICS

1.1. Before you read the passage talk about these questions.

1. What measuring instruments do you know?
2. Where are measuring instrument used?
3. What are measurements necessary for?

1.2. Read the text quickly.
Write the number of the paragraph (1-5) that tells you about:

a) measuring systems________________
b) conditions under which measurements are made____________
c) purpose of measurements____________________
d) field of application__________________
e) special feature______________________

1. Methods of electronic measuring were invented and developed simultaneously with the emergence and development of radio engineering and electronics and are based on the measuring methods used for electric quantities. Electronic measurements are necessary for the development, production, and use of equipment in radio communications, television, and radar, as well as for automation, technical troubleshooting, computer technology, and the manufacture of electronic instruments and components.

2. Measuring instruments are used in physics, chemistry, biology, medicine, geology, and other scientific fields. One of the most important areas in which electronic measurements are used is the measurement of parameters of electronic and radio components, such as resistors, capacitors, inductance coils, semiconductor devices, and integrated circuits.

3. Distinctive feature of electronic measurements is the multiplicity of the quantities and the wide ranges of the values measured, for example, voltages of 10-8 to 103 volts, powers of 10-16 to 108 watts, and frequencies of 104 to 1012 hertz.

4. In measuring the parameters of electronic equipment, it is often necessary to use indirect methods, requiring the use not only of measuring instruments but also of auxiliary apparatus, such as generators of voltage and current at various frequencies, operating in a continuous mode or with different types of modulation. Such equipment is also generally combined with electronic meters of oscillation.

5. Electronic measurements are made under laboratory, production and field conditions. The instruments used for laboratory measurements feature high accuracy and stable parameters; they may have digital readouts of the measured quantities or dials with pointer indicators and manual adjustments.

Figure 1.1 - Measuring System

1.3. Find the meaning of the words and phrases.

quantity	- генератор
equipment	- коливання
radio communication	- знаходження пошкоджень та їх усунення
troubleshooting	- радіозв'язок
current	- величина
voltage	- частота
power	- струм
frequency	- напруга
oscillation	- обладнання
generator	- потужність

1.4. Work in pairs. Discuss:

- the most important areas in which electronic measurements are used;
- conditions they are made under;
- accuracy and features of instruments for laboratory measurements

UNIT 2. AMMETER

2.1. Before reading the text try to answer the following questions.

1. What is an ammeter used for?
2. What types of ammeters do you know?

2.2. Read the text, translate it and check your answers.

When a meter is used to measure electric current, it is referred to as an *ammeter* (from ampere meter). The standard schematic symbol for a meter is shown in Fig.2-1, 2-2. Letters are generally placed within the circle to indicate exactly what kind of meter is being used. The letter A means the unit is an ammeter.

Because the ampere is a rather large unit for an electronic circuit, *milliammeters,* or *microammeters* are frequently used instead. All three types of ammeters work in exactly the same way – the only difference is the range of values they are capable of measuring.

To measure current, the meter must actually be inserted into the circuit itself. In other words, the meter is placed in series with the circuit. This arrangement is shown in Fig.2-1. Remember that in a series circuit the current is equal at all points, so if an ammeter is placed in series with the rest of the circuit, the same current that flows through the circuit will flow through the meter.

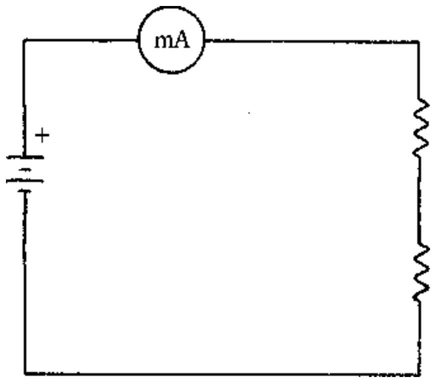


Figure 2.1 - Connection of ammeter in the circuit

Because an ammeter must be used in series with the circuit it is testing, one of the connections in the circuit has to be physically disconnected, so the ammeter can be inserted. Often this requires desoldering.

Quite often it is necessary to measure a current that is larger than the available meter can handle. This problem can be taken care of with a *shunt resistance*, that is, a resistor in parallel with the meter movement. See Fig.2-2.

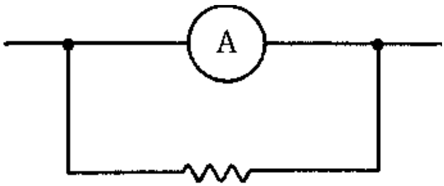


Figure 2.2 - Shunt resistance across an ammeter

Of course, all shunt resistors should have the tightest tolerance possible. Resistors with a 1% tolerance are generally essential, but 5% resistors can be adequate in some uncritical applications. The tolerance should never be more than 5%.

2.3. Work in pairs.

1. **Ask your partner to explain:**

- in which way an ammeter is usually placed in the circuit;
- what tolerance all shunt resistors should have.

2. **Let your partner draw the arrangement of the circuit with an ammeter and comment on what happens when current flows through it.**

UNIT 3. VOLTMETER

3.1. Before you start reading discuss these questions:

1. What is a voltmeter assigned for?
2. What types of a voltmeter do you know?

3.2. Read the text quickly. Match these phrases from the text (1-4) with the definitions (a-d)

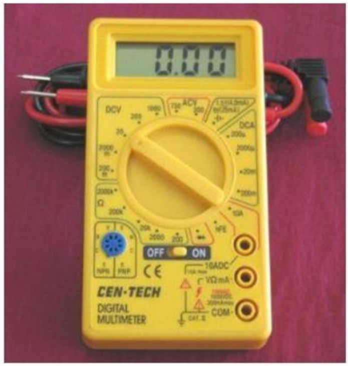
1. voltage meter	a) can measure low or radio frequency voltage
2. digital voltmeter	b) includes a current meter and high resistance
3. special-purpose voltmeter	c) shows voltage as numerals
4. analog voltmeter	d) measures the potential difference

1. A voltmeter, also known as a voltage meter, is an instrument used for measuring the potential difference, or voltage, between two points in an electrical or electronic circuit. Some voltmeters are intended for use in direct current (DC) circuits; others are designed for alternating current (AC) circuits. Special-purpose voltmeters can measure radio frequency (RF) voltage.

2. A conventional analog voltmeter consists of a sensitive galvanometer (current meter) in series with a high resistance. The internal resistance of a voltmeter must be high. Otherwise it will draw significant current, and thereby disturb the operation of the circuit under test.

3. A digital voltmeter shows voltage directly as numerals. Some of these meters can determine voltage values to several significant figures. Practical laboratory voltmeters have maximum ranges of 1000 to 3000 volts (V). Most commercially manufactured voltmeters have several scales, increasing in powers of 1O; for example, 0-1 V, 0-10 V, 0-100 V, and 0-1000 V.

Analog Voltmeter



Digital Voltmeter

Figure 3.1 - Voltmeters

3.3. Answer these questions:

1. Why must the internal resistance of an analog voltmeter be high?
2. What maximum voltage ranges practical laboratory voltmeters are designed for?
3. How many scales have most commercial voltmeters?

UNIT 4. ELECTRONIC DISPLAY DEVICES

4.1. Before reading the passage answer this question:

1. What is the difference between conventional measuring devices and displaying devices?

4.2. Read the text quickly. Find the correct definitions (a-c) to the abbreviations in the text. Translate them.

a. cathode-ray tube
b. liquid-crystal display
c. visual display unit

A display unit is an electronic device with an output surface that displays, or is capable of displaying moving graphical images or visual representation of image sequences or pictures, ... including, if applicable, a device that is an integral part of the display, in that it cannot be easily removed from the display by the consumer. A VDU may use a CRT, LCD, gas plasma, digital light processing or other image projection technology.

Figure 4.1 - Electronic Display Devices

UNIT 5. DIGITAL-TO-ANALOG CONVERTERS (DAC)

5.1. Before you read the passage talk about these questions.

1. What does digital-to-analog converter (DAC) do in the circuit?
2. What does analog-to-digital converter (ADC) do in the circuit?

5.2. Read the text quickly.
Write the number of the paragraph (1-3) that tells you about:

a) what function ADC performs____________________
b) what function DAC performs____________________
c) what kind of output appears when DAC is used to decode the binary digital signals__________________________

1. Digital-to-analog conversion is a process in which signals having a few (usually two) defined levels or states (digital) are converted into signals having a theoretically infinite number of states (analog). A common example is the processing, by a modem, of computer data into audio-frequency (AF) tones that can be transmitted over a twisted pair telephone line. The circuit that performs this function is a digital-to-analog converter (DAC).

2. Basically, digital-to-analog conversion is the opposite of analog-to-digital conversion. In most cases, if an analog-to-digital converter (ADC) is placed in a communications circuit after a DAC, the output digital signal is identical to the input digital signal. Also, in most instances when a DAC is placed after an ADC, the output analog signal is identical to the input analog signal.

3. All binary digital impulses, appear as long strings of ones and zeros, and have no apparent meaning to a human observer. But when a DAC is used to decode the binary digital signals, meaningful output appears. This might be a voice, a picture, a musical tune, or mechanical motion. Both the DAC and the ADC are of significance in some applications of digital signal processing.

5.3. Read the sentences. Choose where the words best fit the blanks:
input analog signal / input digital signal.

1. If ADC is placed in the circuit after DAC, the output digital signal is identical to ____________________________________
2. If DAC is placed in the circuit after ADC, the output analog signal is identical to ____________________________________

5.4. Discuss:

- a process of a digital-to-analog conversion
- the output that appears when DAC is used to decode the binary digital signals

UNIT 6. FREQUENCY METER

6.1. Before reading the text answer the question:

What is a frequency meter used for?

6.2. Read the text quickly.
Match the headings (a-c) with the paragraphs (1-3)

a) connection of a frequency meter
b) exceeding the set frequency
c) definition of a frequency and a frequency meter

1. A frequency meter is an electronic instrument that measures frequencies of light and sound waves. Frequency is defined as being the amount of times a particular sound or light waveform occurs within a given period of time, and the frequency meter counts these occurrences and their duration. A frequency meter can detect and display the frequencies of sounds and light waves below and above the detection ability of the human eyes and ears for a full spectrum of each.

2. The input signal a frequency meter receives usually comes from one of several kinds of input/output interfaces. These can be RS232 serial data ports, universal serial bus (USS) ports, Ethernet data link connections, or general purpose interface bus (GPIB) test equipment connections.

3. Besides notifying of frequencies, a frequency meter can send alerts when frequencies have been exceeded. A menu interface can receive settings for what frequencies are allowable and program the frequency meter to either sound an alarm or shut down operation when frequencies are exceeded for a duration beyond a set period of time.

Figure 6.1 - Frequency Meter

6.3. Match the abbreviations (1-4) with their definitions (a-d). Translate them.

1. SDP
2. GPP
3. USB
4. GPIB

a. universal serial bus
b. general-purpose interfase bus
c. serial data port
d. general-purpose port

6.4. Discuss the following questions.

1. What is a frequency?
2. What can a frequency meter do?
3. Where ia a frequency meter connected to?
4. What does a frequency meter do when the set frequency is exceeded?

UNIT 7. DIGITAL OSCILLOSCOPE

7.1. Before reading the text talk about the fields where a digital oscilloscope is used in.

7.2. Read the text quickly.
Write the number of the paragraph (1-3) that tells you about:

a) a sensor included into a digital oscilloscope ______________.
b) activities a digital oscilloscope is necessary to use in _______.
c) application of a digital oscilloscope in automotive industry, medical researches ________________ .

1. The digital oscilloscope is an indispensable tool for anyone designing, manufacturing or repairing electronic equipment. In today's fast-paced world, engineers need the best tools available to solve their measurement challenges quickly and accurately. As the eyes of the engineer, digital oscilloscopes are the key to meeting today's demanding measurement challenges.

2. The usefulness of a digital oscilloscope is not limited to the world of electronics. With the proper sensor, a digital oscilloscope can measure all kinds of phenomena. A sensor is a device that creates an electrical signal in response to physical stimuli, such as sound, mechanical stress, pressure, light, or heat. A microphone is a sensor that converts sound into an electrical signal.

3. Digital oscilloscopes are used by everyone from physicists to repair technicians. An automotive engineer uses a digital oscilloscope to correlate analog data from sensors with serial data from the engine control unit. A medical researcher uses a digital oscilloscope to measure brain waves. The possibilities are endless.

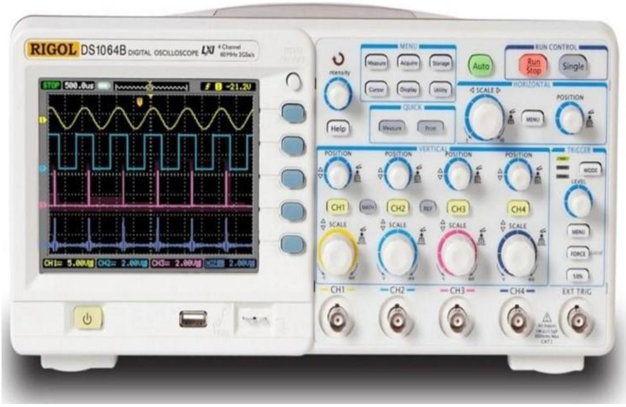


Figure 7.1 - Digital Oscilloscope

6. **Answer these questions:**

1. What is a sensor?
2. What is a microphone?
3. What does an automotive engineer use a digital oscilloscope for?
4. What does a medical researcher use this instrument for?

UNIT 8. ELECTRIC POWER MEASUREMENT

8.1. Before you start reading answer these questions.

1. What is an electric power?
2. What units is an electric power measured in?

8.2. Read the text quickly.
Match the headings (a-d) with the paragraphs (1-4):

a) electric power
b) measuring phase difference in a.c.circuits
c) measurement of power by using Ohm's law
d) measuring of power in a d.c.circuit

1. A measurement of the time rate at which electrical energy is being transmitted or dissipated in an electrical system. The potential difference in volts between two points is equal to the energy per unit charge (in joules/coulomb) which is required to move electric charge between the points. Since the electric current measures the charge per unit time (in coulombs/second), the electric power **P** is given by the product of the current **I** and the voltage **V** (in joules/second = watts).

2. Alternate forms of the basic definition can be obtained by using Ohm's law, which states that the voltage across a pure resistance is proportional to the current through the element.

3. The measurement of power in a dc circuit can be carried out by simultaneous measurements of voltage and current by using standard types of dc voltmeters and ammeters. The product of the readings typically gives a sufficiently accurate measure of dc power. If great accuracy is required, corrections for the power used by the instruments should be made.

4. In ac circuits the phase difference between the voltage and current precludes use of the voltmeter-ammeter method unless the load is known to be purely resistive.

Figure 8.1 - Electric power measuring instrument

8.3. Speak about:

1. What is a measurement of electric power?
2. What is a potential difference?
3. What does an electric current measure?
4. What does Ohm's law state?
5. How can you measure the power in a d.c.circuit?
6. What does the phase difference between voltage and current in a.c.circuits preclude? When?

UNIT 9. MEASUREMENT OF DISTORTION

9.1. Before you read the passage answer the question.

What do you know about a distortion of a signal?

9.2. Read the passage quickly.
Match the headings (a-b) with the paragraphs (1-2):

a) classification
b) definition
c) measurement

1. Over the years, distortion in amplifiers and other electronic devices has been measured by many different techniques. Some of these techniques have changed with the development of modern test equipment using computer-based technology. The old techniques are still valid and utilise test equipment more likely to be available to the radio amateur.

2. Distortion in any signal processing device (such as an amplifier) can be defined as any output signal component, generated within the device from the input signal, but which is different in form from the original input signal.

3. Distortion is generally classified separately from noise which is generated within the device independent of the input signal. Distortion can be classified under a number of different headings. The most common of these are as follows:

- Frequency or amplitude distortion.
- Harmonic distortion.
- Inter-modulation distortion.
- Phase distortion.

9.3. Work in pairs. Let your partner explain:

- Where a distortion of a signal can occur
- How a distortion is defined
- If a distortion is generated in combination with a noise within the device
- What the most common kinds of a distortion are known

UNIT 10. OHMMETER

10.1. Before reading the passage talk about these questions.

1. What does an ohmmeter measure?
2. Does it perform other functions?

10.2. Read the passage quickly and check your answers

An ohmmeter can be independent or it can be a part of another, more common, electrical testing device called a multi-meter.

An ohmmeter is used to check the continuity of a circuit and tells how much resistance is in a circuit.

Use an ohm meter to check continuity in motors, cables, or fuses.

If a circuit has a break in continuity, it is called "open" (it has a break in it).

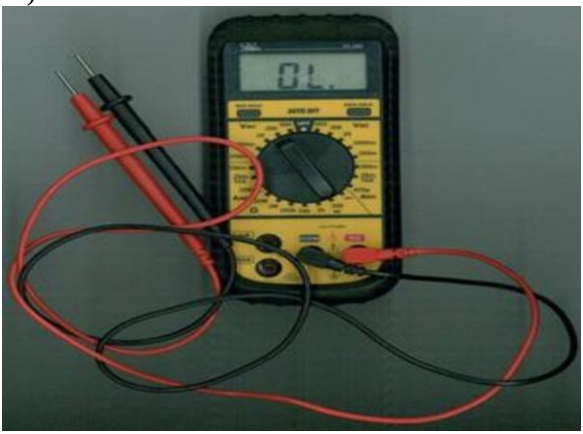


Figure 10.1 - Ohmmeter

UNIT11. VOLT-OHM-MILLIAMMETER (VOM)

11.1. Before reading the text answer these questions.

1. How is a combination of voltmeter, ohmmeter and milliammeter called?
2. What can this instrument measure?

11.2. Read the text quickly.
Write the number of the paragraph (1-4) that tells you about:

a) vacuum-tube voltmeter (VTVM) ________________________
b) calibration of a VOM scale face ________________________
c) ranges of resistances within which measurements with VOM can be made ____________________________
d) connection of resistors into the circuit of the instrument for different types of measurement

1. Probably the most commonly used piece of equipment in electronics work is the *VOM*. *VOM* stands for *volt-ohm-milliammeter*. Various resistors are switched in and out of series or parallel to set up the meter for each type of measurement. An internal battery is included for resistance measurements. Some VOMs do not have the capability to measure current directly, and many are designed for dc use only.

2. Usually any of a number of different value resistances can be switched into the circuit, so measurements can be made within different ranges. Whichever range is easiest to read for a specific value can be easily selected, 10mV would probably be very difficult to detect on a meter scale that went up to 100V.

3. The scale face of a VOM has a number of sets of calibration markings, so each of the metering functions can be read directly. Usually the different ranges are multiples of 10 of the basic range, so converting the reading to the appropriate range is simply a matter of mentally adding the correct number of zeros. For example, a reading of 1.5 on an x 100 range would indicate a value of 150.

4. Closely related to the VOM is the VTVM, or *vacuum-tube voltmeter*. This device is operated by an ac power supply and has an extremely high input impedance, and therefore it has a very high degree of accuracy. The disadvantages of the VTVM are its greater cost and complexity, and the fact that it must be plugged into an ac wall socket, which limits its portability

11.3. Work in pairs. Let your partner explain:

- what measuring instrument has a very high degree of accuracy
- disadvantages of a vacuum-tube-volt-meter

UNIT12. Q-METER

12.1. Before you read the text answer these questions.

1. What does a Q-factor mean?
2. What is a Q-meter used for?

12.2. Read the text quickly.
Match the headings (a-d) with the paragraphs (1-4):

a) circuit of a Q-meter
b) defininon of a Q-meter
c) reading a Q-factor
d) affects on a Q-factor

1. A Q-meter is a piece of equipment used in the testing of radio frequency circuits. It has been largely replaced in professional laboratories by other types of impedance measuring device, though it is still in use among radio amateurs. It was developed at Boonton Radio Corporation in Boonton, New Jersey in 1934 by William D. Loughlin.

2. Internally, the most commonly used Q-meter consists of a tuneable RF generator with a very low impedance output and a detector with a very high impedance input. There is usually provision to add a calibrated amount of high Q capacitance across the component under test to allow inductors to be measured in isolation.

3. The generator is effectively placed in series with the tuned circuit formed by the components under test, and having negligible output resistance, does not substantially affect the Q-factor, while the detector measures the voltage developed across one element (usually the capacitor) and being high impedance in shunt does not affect the Q-factor significantly either.

4. The ratio of the developed RF voltage to the applied RF current, coupled with knowledge of the reactive impedance from the resonant frequency, and the source impedance, allows the Q-factor to be directly read by scaling the detected voltage.

Figure 12.1 - Q-meter

12.3. Decide if the sentences are true (T) or false (F)

1. It is usually possible to connect a calibrated capacitance across the component being under testing.
2. A generator is connected in parallel with the circuit of the components being tested.
3. The ratio of RF voltage to RF current taken together with reactive and source impedance doesn't allow to read the Q-factor by scaling the detected voltage.