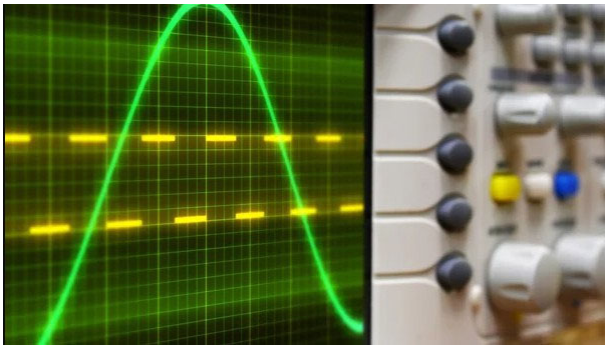
Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Department of Radio Engineering

Fundamentals of metrology (GT-11)



Curriculum of the academic discipline (Syllabus)

Course details

Level of higher education	First (bachelor's)
Field of knowledge	-
Specialty	
Educational program	172B RTS - Radio Engineering Information Technologies (EDEBO id: 6842)172B ROS - Radio Communications and Signal Processing (EDEBO id: 6364)172B ITR - Intelligent Technologies of Radio Electronics (EDEBO id: 49229)172B ITMR - Intelligent Technologies of Microsystem Radio Electronics (EDEBO id: 5627)172B ICR - Information and Communication Radio Engineering (EDEBO id: 49228)172B RCS - Radio Engineering Computerized Systems (EDEBO id: 49227)172B ITRET+ - Intelligent Radio Engineering Technologies (EDEBO id: 57907)172B ICRI+ - Information and Communication Radio Engineering (EDEBO id: 57910)172B RTKS+ - Radio Engineering Computerized Systems (EDEBO id: 57920)172B TREB - Radio Electronic Warfare Technologies (EDEBO id: 63920)G5B TREB - Radio Electronic Warfare Technologies (EDEBO id: 83615)G5B ITRET - Intelligent radio-electronic engineering technologies (EDEBO id: 83616)G5B ICRI - Information and Communication Radio Engineering (EDEBO id: 83618)G5B RTKS - Radio Technical Computerized Systems (EDEBO id: 83620)
Status of the discipline	Regulatory Full-time
Form of higher education	1 course, spring semester
Year of training, semester	3 credits (Lectures 18 hours, Practical hours, Lab 36 hours, Independent work hours)
Scope of the discipline	Credit
Semester control/control measures	https://schedule.kpi.ua
Class schedule	Lecturer: Zakharchenko O. S., Lab: Zakharchenko O. S.,
Language of instruction	
Information about the course supervisor/teachers	

Course location https://do.ipo.kpi.ua/course/view.php?id=1267

Curriculum

1. Description of the course, its purpose, subject matter, and learning results

The academic discipline "Fundamentals of Metrology" (FM) is one of the disciplines in the general training cycle for specialists in the specialty 172 "Electronic Communications and Radio Engineering."

The disciplines that provide the prerequisites are: "Higher Mathematics" and "General Physics." FM provides the basis for the study of all, without exception, further disciplines of the radio engineering profile studied by students majoring in 172 "Electronic Communications and Radio Engineering."

The purpose of studying the discipline of FM is to familiarize students with the basic concepts of measurements, errors, types of signals, and the basic methods of processing measurement information regarding the parameters of radio engineering devices.

According to the curriculum, the discipline consists of lectures and laboratory classes. Depending on the amount of classroom time provided by the working curriculum, individual theoretical sections of the discipline may be assigned for independent study. The discipline is studied over one semester in the form of a single credit module.

During the course, students acquire the following general competencies (GC), professional competencies (PC), and program learning results (PLR):

GC 2 Ability to apply knowledge in practical situations

GC 4 Knowledge and understanding of the subject area and understanding of professional activities

PC 6 Ability to perform instrumental measurements in information and telecommunications networks, telecommunications and radio engineering systems.

PC 10 Ability to install, debug, configure, adjust, test, and commission telecommunications and radio engineering structures, facilities, and equipment.

PLR 3 Identify and apply in professional activities methods for testing information and telecommunications networks, telecommunications and radio engineering systems for compliance with the requirements of domestic and international regulatory documents;

PLR 7 Competently apply terminology in the field of telecommunications and radio engineering;

PLR 16 Apply an understanding of the basics of metrology and standardization in the field of telecommunications and radio engineering in professional activities.

2. Prerequisites and post-requisites of the discipline (place in the structural-logical scheme of training under the relevant educational program)

To successfully complete the course, students need basic knowledge of the disciplines "Introduction to the Specialty."

Post-requisites - "Fundamentals of Circuit Theory".

3. Course content

The course "Fundamentals of Metrology" is designed for first-year students majoring in Telecommunications and Radio Engineering. The course includes: 18 hours of lectures, 36 hours of laboratory work, calculate graphical work (CGW), and a module test (MT).

Class topics:

1. Metrology and its significance in scientific and technical progress
2. Physical quantities and their units of measurement
3. Types and methods of measurement, basic concepts and definitions
4. Measurement errors
5. Processing of observation results and evaluation of measurement errors
6. Basics of measurements in electromagnetic circuits
7. Methods and means of radioelectronic measurements
8. Frequency measurement
9. Voltage measurement
10. Power measurement
11. Phase shift measurement
12. Oscillographic studies of oscillation forms
13. Measuring generators

Laboratory works involve mastering practical skills in working with radio equipment and identifying measurement errors:

1. Decibels (computer workshop)
2. Methods for finding phase shift
3. Research and measurement of resistor and capacitor parameters
4. Research of AM signals
5. Oscillographic research methods
6. Determination of signal frequency
7. Computer workshop (signal forms and relationships between them)
8. Computer workshop 3

4. Teaching materials and resources

1. Fundamentals of metrology: lecture notes [Electronic resource]: textbook for students majoring in 172 "Electronic Communications and Radio Engineering" / O.S. Zakharchenko; Igor Sikorsky KPI. – Electronic text data (1 file, 3.858 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 127 p.

2. Fundamentals of Metrology: Home Assignment [Electronic resource]: textbook for students majoring in 172 "Electronic Communications and Radio Engineering" / O.S. Zakharchenko; Igor Sikorsky Kyiv Polytechnic Institute. – Electronic text data (1 file, 329 KB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 12 p.

3. Fundamentals of Metrology: Textbook [Electronic resource]: textbook for students majoring in 172 "Telecommunications and Radio Engineering" / Igor Sikorsky Kyiv Polytechnic Institute; comp.: P. O. Demyanenko, Yu. F. Zinkovsky. – Electronic text data (1 file: 3.33 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2018. – 237 p.
4. Wikipedia — Access mode: https://uk.wikipedia.org/wiki/%D0%9C%D1%96%D0%B6%D0%BD%D0%B0%D1%80%D0%BE%D0%B4%D0%BD%D0%B0_%D1%81%D0%B8%D1%81%D1%82%D0%B5%D0%BC%D0%B0_%D0%BE%D0%B4%D0%B8%D0%BD%D0%B8%D1%86%D1%8C_(SI) — Title from the screen
5. N.M. Pindus. Fundamentals of Metrology and Information Measurement Technologies. Lecture Notes. - Ivano-Frankivsk: Fakel, 2010.- 345 p.
6. Podzharenko V.O., Kulakov P.I., Ignatenko O.G., Voitovich O.P. Fundamentals of Metrology and Measurement Technology. Textbook. – Vinnytsia: VNTU, 2006. – 151 p.
7. Metrology, Standardization, and Quality Management L.P. Klymenko, L.V. Pizintsa, N.I. Aleksandrovskaya, V.D. Evdokimov – Mykolaiv: Petro Mohyla Black Sea National University Publishing House, 2011
8. Metrology, Standardization, Certification: Textbook for Students of Higher Educational Institutions / L.M. Vitkin, O.I. Momot, V.U. Ignatkin, O.V. Miroshnychenko, N.V. Gorodnychuk, P.I. Samoilov;

KROK University of Economics and Law. - Kyiv, 2011. - 301 p. - Ukrainian.
9. Planning Experiments and Processing Their Results: Textbook / V. U. Ignatkin, O. V. Ryazantsev, O. M. Syanov, V. A. Litvinenko; Dniprodzerzhynsk State Technical University. - Dniprodzerzhynsk, 2010. - 156 p. - Bibliography: 10 titles. - Ukrainian.
10. Radio Measurements: A Textbook for Laboratory Work and Test Assignments (for students majoring in Radio Engineering in all forms of education) compiled by O.G. Khandozhko. Chernivtsi National University, 2011. 67 p.
11. Electrical and Radio Engineering Measurements: A Guide for Teachers and Students of Vocational and Technical Educational Institutions / A.M. Gurzhii, N.I. Povozyniuk. - Kyiv: Educational Book, 2002. - 287 p.

Educational content

5. Methodology for mastering the academic discipline (educational component)

The course "Fundamentals of Metrology" is designed for first-year students majoring in Telecommunications and Radio Engineering. The course includes: 18 hours of lectures, 36 hours of laboratory work, group work, and a modular test.

Lecture topics:

1. Metrology and its significance in scientific and technical progress. physical quantities and their units of measurement
2. Types and methods of measurement
3. Basic concepts and definitions
4. Measurement errors
5. Processing of observation results and evaluation of measurement errors
6. Basics of measurements in electromagnetic circuits
7. Methods and means of radioelectronic measurements. frequency measurement
8. Voltage measurement. power measurement. phase shift measurement
9. Oscillographic studies of oscillation forms. Measuring generators

6. Independent work by students

The course includes a home assignment, which must be completed within one month.

1.1. The test should be completed on separate sheets of paper, in ink or paste (not red!), in clear handwriting, leaving 30 mm margins for the reviewer's comments.

1.2. The title page of the notebook must clearly indicate: the name of the discipline, the student's surname, first name, and patronymic (in full), the name of the faculty, and the group number.

1.3. Do not start the test without studying the relevant sections of the course and solving the recommended sample problems. If the basic principles of the theory are poorly understood and little attention is paid to solving sample problems, serious difficulties will arise when completing the tests. Assignments that are not completed independently are not subject to review; assignments that are submitted after the deadline are considered according to a separate schedule.

1.4. Before solving each problem, you should write down its conditions in full with numerical data and make a neat sketch indicating all the values necessary for the solution.

1.5. The solution should be accompanied by brief explanations (without abbreviating words) and clear sketches showing all the values used in the calculations. Explanations should be brief; do not retell the textbook; use technical language—drawings and formulas. When using formulas or other data, refer to the source and provide a list of references at the end of the work.

1.6. Solutions to problems should be presented in algebraic form (without substituting numbers) only when studying the influence of different parameters.

1.7. The results of calculations should contain a reasonable number of significant digits.

1.8. The final results should be highlighted. They should include the dimension.

Policy and control

7. Policy of the academic discipline (educational component)

The grading system should provide for maximum student workload during laboratory classes throughout the semester. The main focus is on attendance and independent completion of laboratory work assignments.

A student's credit module grade consists of points awarded for:

1. Completion and defense of 5 laboratory works, maximum number of points — 30;
2. Completion and defense of 1 DCR, maximum number of points 18
3. Completing 3 practical assignments. Maximum number of points: 3*2=6
4. Writing module tests. Maximum number of points: 38
5. Monitoring attendance at classes: 10 points in total.

Rating point system

1. Laboratory work

Defense of work:

– full mastery of the material during the defense (at least 90% of the required information) — 5 points;

– partial mastery of the material (at least 75%) — 4 points;

– satisfactory knowledge of the material (at least 60%) — 3 points;

– unsatisfactory mastery of the material (less than 60%) — 0 points;

The laboratory work is considered successfully defended if the student scores 1 point out of a possible 5. If the student scores less than 1 point, the work must be defended again.

One point is deducted for each unsuccessful attempt at defense.

2. Homework is considered successfully completed if the student scores 1 point out of a possible 18 and complies with all the requirements for homework. If the requirements for formatting are not met, the work must be redone.

One point is deducted for each day the work is late.

3. Completion of practical work

Correct and complete completion of the work is awarded two points.

4. Writing modular tests (MT)

Modular tests are conducted in the form of tests on the Sikorsky platform during lectures.

The maximum number of points is 38.

Failure to complete the MT within the specified time limit does not result in penalty points and does not require mandatory completion.

5. Attendance at lectures

Attendance is monitored in all classes and is assessed in the corresponding number of points. The maximum possible total value is limited to 10 points at the end of the semester.

To receive points for attendance at lectures, one absence without a valid reason is permitted.

6. Bonus and penalty points

The maximum number of points is 100. The defense of all laboratory work and the completion of the DCR is a prerequisite for admission to the exam!

Students who have earned more than 60 points during the semester are entitled to receive an "automatic" grade, and points are converted to *ECTS* grades according to the table.

Students who have earned less than 60 points, as well as those who want to improve their *ECTS* grade, must complete a test, and their semester rating is reset to zero.

8. Types of assessment and the Learning outcomes assessment Rating System (LRS)

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Table of correspondence between rating points and grades on the university scale

Number of points	Grade
100-95	Excellent
94	Very good
84	Good
74-65	Satisfactory
64-60	Sufficient
Less than 60	Unsatisfactory
Admission requirements not met	Not admitted

9. Additional information on the discipline (educational component)

The laboratory facilities include modern radio equipment: oscilloscopes, generators, multimeters

Description of material, technical, and informational support for the discipline

The laboratory facilities include modern radio equipment: oscilloscopes, generators, multimeters

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Work program for the academic discipline (syllabus):
Compiled by Zakharchenko O. S.;
Approved by the RI Department (Minutes No. 06/2024 dated 06/23/2024)
Approved by the methodological commission of the faculty/research institute (protocol No. 06-2024 dated 28.06.2024)