



[RE-250] DESIGN OF MICROWAVE RECEIVING DEVICES. COURSEWORK (PN-13)



Work program for the academic discipline (Syllabus)

Course details

Level of higher education	First (bachelor's)
Field of knowledge	17 - Electronics, automation, and electronic communications
Special	172 - Electronic communications and radio engineering
Educational program	172B ICR - Information and Communication Radio Engineering (EDEBO id: 49228)172B ICRI+ - Information and Communication Radio Engineering (EDEBO id: 57910)
Discipline status	Regulatory
Form of higher education	Full-time
Year of training, semester	3rd year, spring semester
Scope of the discipline	1 credit (lectures, practical classes, laboratory classes, self-study: 30 hours)
Semester control/control measures	Test
Class schedule	https://schedule.kpi.ua
Language of instruction	Ukrainian
Information about the course leader/teachers	Lecturer: Peregudov S. M. , Practical classes: Peregudov S. M. , Lab: Peregudov S. M. , Self-study: Peregudov S. M.
Course location	https://classroom.google.com/c/NDEyNjQ0NDU4NzY5?cjc=kfejwkt https://do.ipu.kpi.ua/course/view.php?id=2703

Curriculum

1. Description of the academic discipline, its purpose, subject matter, and learning outcomes

The academic discipline "Design of microwave receiving devices. Coursework" refers to the normative educational components of the curriculum, namely to the PN14 professional training cycle of the professional educational program.

Reasons and motivation for studying: the necessity of the academic discipline "Design of Microwave Receiving Devices. Coursework" is to consolidate, deepen, and generalize the theoretical knowledge and practical skills that students acquire while studying the discipline "Design of Microwave Receiving Devices," as well as to understand the principles of designing microwave range radio receiving devices.

The aim of teaching the discipline is to develop knowledge of the methods and means of designing microwave range receiving devices, the principles of calculating the parameters of electrical signals of microwave range receiver path nodes, and the basic technological operations of the production process.

The subject of the discipline is the basic methods of designing microwave receiving devices, calculating their main technical characteristics, and determining operating conditions.

As a result of training, students develop:

General competencies (GC)

GC 2 Ability to apply knowledge in practical situations.

Professional competencies (PC)

PC 18 Ability to analyze, evaluate characteristics, and design modern low-noise microwave receivers for information and communication systems.

Studying the discipline "Design of microwave receiving devices. Course work" contributes to the achievement of the following **program learning results**

Program learning results (PLR)

PLR 1 Analyze and make informed decisions when solving specialized tasks and practical problems in telecommunications and radio engineering, which are characterized by complexity and incomplete certainty of conditions.

PLR 25 Select and implement means and methods of information transmission in communication networks and apply network technologies.

Within the framework of the above-defined general and professional competencies and program learning results, students should:

know the physical principles of operation of microwave receiving devices and their components; basic technical characteristics of the most important nodes; modeling and calculation methods used at the stage of their development;

be able to use the acquired knowledge in the design of microwave receivers, the development and operation of equipment in which they are included; analyze the conversion of signals by components of microwave receiving devices.

Students **gain experience** working with individual components of the above-mentioned equipment and their application in the creation of telecommunications systems.

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

Interdisciplinary connections are determined by the place of the discipline "Design of Microwave Receiving Devices" in the educational and professional training program for specialists in the field of electronics and telecommunications.

To successfully study the discipline "Design of Microwave Receiving Devices. Coursework" (PN14), students must master the material and have certain knowledge, abilities, and skills in such disciplines as:

- "Higher Mathematics" (ZO 07.1-3);
- "General Physics" (ZO 08.1,2);
- "Microwave Devices" (PN10);
- "Antennas" (PN11);
- "Design of Microwave Receiving Devices" (PN12).

The course "Design of Microwave Receiving Devices. Coursework" provides study of first-level (bachelor's) higher education disciplines:

- "Automated Design of Antennas and Microwave Devices" (PN06);
- "Design and manufacture of microwave equipment" (PN15);
- as well as during diploma design.

3. Content of the academic discipline

The course paper is completed as an individual assignment and prepared for defense at the end of the theoretical training period. The course paper must be prepared for defense by the deadline specified in the assignment and agreed upon with the instructor. **An explanatory note** is submitted for the defense of the course paper and contains:

- title page;
- technical assignment;
- table of contents;
- introduction;
- main part (structural diagram and its justification, results of calculating the main parameters of the microwave receiving device);
- conclusions;
- list of references.

The main stages of completing the coursework:

- receiving the topic and assignment;
- analyzing the assignment;
- selecting and studying literature;
- selection and justification of the structural diagram of the receiving device;
- designing radio receiver circuit blocks;
- calculation of the main parameters of the radio receiver device;

- preparation of an explanatory note;
- submission of an explanatory note for review;
- defense of the course work.

4. Teaching materials and resources

Recommended reading

Basic

1. Designing microwave receiving devices: Coursework: textbook for students majoring in 172 "Electronic Communications and Radio Engineering"/ Igor Sikorsky Kyiv Polytechnic Institute; compiled by: S. M. Peregudov. – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 45 p. Approved by the Methodological Council of Igor Sikorsky Kyiv Polytechnic Institute (protocol No. 5 of 23.02.2023). Access: <https://ela.kpi.ua/handle/123456789/57279>.
2. Telecommunications Transmission Systems: Textbook / V. M. Kychak, O. M. Shynkaruk, H. H. Bortnyk, I. I. Chesanovskyi, O. V. Stalchenko. – Khmelnytskyi: NADPSU Publishing House, 2016. – 424 p.
3. Wireless technologies for intelligent radio equipment: Radio Receiving and Transmitting Devices: Lecture Course: Textbook for Students Majoring in 172 "Electronic Communications and Radio Engineering" / Igor Sikorsky KPI; Compiled by: V. A. Druzhinin, M. M. Stepanov. – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 599 p.

Additional

4. Theory and practice of radio frequency resource management: textbook / P.V. Slobodyanyuk, T.M. Narytnyk, V.G. Blagodarny, V.G. Saiko, V.L. Bulhach; ed.: V.G. Kryvuts. – Kyiv: DUIKT, 2012. – 595 p.
5. Ilnytskyi L.Ya. Ultra-high frequency devices and antennas: textbook / Ilnytskyi L.Ya., Sibruk L.V., Shcherbina O.A. – Kyiv: NAU, 2013. – 188 p.
6. Pozar, D.M. Microwave Engineering / David M. Pozar – 4th ed. – John Wiley & Sons, 2012. – 752 p.
7. DSTU GOST 2.001:2006 Unified system of design documentation. General provisions (GOST 2.001-93, IDT).
8. DSTU GOST 2.051:2006 Unified system of design documentation. Electronic documents. General provisions (GOST 2.051-2006, IDT).
9. DSTU ISO 5457:2006 (ISO 5457:1999, IDT) National Standard of Ukraine. Technical documentation for products. Drawings. Dimensions and formats.
10. DSTU GOST 2.702:2013 ESKD. Rules for the execution of electrical diagrams (GOST 2.702-2011, IDT).
11. DSTU 3008-2015 "State Standard of Ukraine. Documentation. Reports in the field of science and technology. Structure and rules of design."

Information resources

- I. Microwaves101.com (Microwave Encyclopedia) [Electronic resource] – Access mode: <https://www.microwaves101.com>.

II. Microwave Journal [Electronic resource] – Access mode:
<http://www.microwavejournal.com>. III. RF and millimeter-Wave Circuit Design [Electronic resource] – Access mode

Access mode: <https://www.coursera.org/learn/rf-mmwave-circuit-design>

Educational content

5. Methods of mastering the academic discipline (educational component)

The completion of the coursework consists of nine stages, which are listed in the table:

Semester week	Name of stage
3	Receiving the topic and assignment
4	Analysis of the assignment
6	Selection and study of literature
8-10	Selection and justification of the structural diagram of the receiving device
11	Designing radio receiver circuit blocks
14	Calculation of the main parameters of the radio receiver device
15	Preparation of an explanatory note
16	Submission of a course project (work) for review
17	Defense of the course project (work)

6. Self-study of the student

No	Title of the topic for independent study	Number of hours SS
1	Receiving the topic and assignment for the term paper	1
2	Analysis of the assignment, selection and study of literature	5
3	Development of a structural diagram of the receiving device and its signal processing blocks	20
4	Preparation of an explanatory note for the course work	4
	Total:	30

Policy and control

7. Policy on academic discipline (educational component)

The formatting of the course paper must comply with the requirements for reports on research and development work (DSTU 3008-2015 "State Standard of Ukraine. Documentation. Reports in the field of science and technology. Structure and rules of formatting").

All illustrative material in the course work must be prepared using computer tools. The content of the illustrative material must sufficiently reflect the main provisions that are being defended.

Both the instructor and the student are required to adhere to the Code of Integrity of the National Technical University of Ukraine "Kyiv Polytechnic Institute".

The main provisions of the academic discipline policy:

- the topic of the course paper may be consistent with the topic of the future bachelor's thesis;
- the stages of the course work must be completed in accordance with the established work schedule;
- the developed structural diagram of the receiving device and the diagrams of its blocks must be confirmed by the results of calculations of their main parameters;
- in case of academic misconduct and plagiarism, the coursework is returned for complete reworking with a possible change in the assignment;
- Failure to complete a stage of the coursework on time will result in a 10% reduction in the explanatory note component of the assessment if the delay is no more than two weeks, and a 20% reduction if the delay is more than two weeks.

Coursework is assessed taking into account the following factors:

- completeness of the individual assignment for the coursework;
- correctness and validity of the developed schemes;
- timeliness of the coursework in accordance with the schedule;
- independence in completing the coursework and absence of signs of plagiarism;
- answers to questions about the content of the coursework during its defense.

8. Types of control and rating system for assessing learning outcomes (RSA)

The system for assessing student performance in the discipline "Design of Microwave Receiving Devices. Coursework" is based on the "Regulations on the system of assessment of learning outcomes at Igor Sikorsky KPI" (https://document.kpi.ua/files/2020_1-273.pdf), namely the Rating Assessment System (RAS) of the second type (RAS-2).

The RSA-2 of the coursework (R_k) has two components:

- initial (R_c);
- defense component (R_3).

$$R_k = R_c + R_D .$$

The first (initial) component R_c characterizes the student's work on the term paper and its result — the quality of the explanatory note and the developed structural diagrams.

The *second* component characterizes the quality of the student's defense of the term paper.

The scale of the first component is **60 points**, and the second component is **40 points**. The quality of the explanatory note and the degree of adherence to the work schedule, weight score – **60 (R_c)**.

The criteria for evaluating the components of the explanatory note are given in the table

No. Stage	Components of the work	Maximum number of points for timely completion	Consideration of timeliness of completion
1	Title page design	2	
2	Availability of the assignment on the CR	2	
3	Presence of content	2	
4	Presence and content of introduction	2	

5	Presence and validity of the structural diagram	10	100% of the grade if the work schedule is followed
6	Availability and validity of electrical diagrams of radio receiver blocks	10	
7	Availability of calculations of the main parameters and characteristics of radio receiver path devices	15	
8	Availability of calculations of the main parameters of the radio receiving device	10	90% in case of delay up to
9	Availability and content of conclusions	5	
10	Availability and formatting of the list of	2	2 weeks
	Total	60	

A student is admitted to the defense of a term paper if he/she has a starting component R_c of at least 60% of the maximum value, which is $60 \times 0.6 = 36$ points.

Quality of defense, weighted score – **40 (R_3)**.

Criteria for evaluating the presentation of the report based on the coursework materials and answers to questions:

- degree of mastery of theoretical material up to 20 points;
- proficiency in the methods of designing and analyzing electrical circuits of receiving devices, up to 20 points in total.

The defense of the term paper is considered successful if R_3 is not less than 60% of its maximum value, i.e.

$40 \times 0.6 = 24$ points.

After the defense of the term paper, R_k is determined, which is then converted into a grade on the university scale according to the table:

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

Number of points	Grade
100-95	Excellent
94	Very good
84-75	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)

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

Computers with the following minimum requirements: 32-bit (x86) or 64-bit (x64) processor with a clock speed of 1 GHz or faster*; 1 gigabyte (GB) of RAM (for 32-bit version) or 2 GB (for 64-bit version); 16 GB (for 32-bit version) or 20 GB (for 64-bit version) of available hard disk space; Graphics device with DirectX 9 support and WDDM 1.0 or later driver.

Software:

- Smith V4.1 (conditionally free software, demo version available): <https://www.fritz.dellsperger.net/smith.html>;
- Qucs-S and NGSpice (free software): <https://ra3xdh.github.io/>

Work program for the academic discipline (syllabus):

Compiled by [S. M. Peregudov](#);

Approved by the PRE Department (Minutes No. 06/2024 dated June 27, 2024).

Approved by the REF Methodological Commission (protocol No. 06/2024 dated 28.06.2024).