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

Department emblem (if available)

Department of Radio Engineering

Fundamentals of Circuit Theory. Part 2

Course syllabus (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	*Intelligent technologies of radio-electronic engineering, Information and Communication Radio Engineering, Radio Engineering Computerized Systems, Radio Electronic Warfare Technologies*
Status of discipline	*Regulatory*
Form of study	*Full-time (day)*
Year of training, semester	*2nd year, fall semester*
Scope of the discipline	*5 credits (36 hours of lectures, 36 hours of practical work, 18 hours of laboratory work, 60 hours of independent study)*
Semester control/control measures	*Exam*
Class schedule	
Language of instruction	*Ukrainian*
Information about the course leader/lecturers	Lecturer: *Andriy V. Bulashenko, PhD in Technical Sciences a.bulashenko@kpi.ua* Practical classes: *Andriy V. Bulashenko, PhD in Technical Sciences* Laboratory: Assistant Professor B.V. Vandilovsky
Course location	https://do.ipo.kpi.ua/course/view.php?id=7476

Curriculum

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

The purpose of the credit module is to develop students' abilities to:

- perform calculations of electrical and electronic circuits of direct and alternating current (periodic and non-periodic), competently compile mathematical models and use computing technology to process them;
- calculate the basic parameters of various types of electronic circuits (oscillatory circuits, four-pole circuits, multipole circuits, long lines, etc.);
- perform circuit analysis in the frequency domain using circuit functions;
- formulate requirements for electronic circuit elements based on their functional purpose.

In accordance with the requirements of the course, after completing the credit module, students should demonstrate the following learning outcomes:

knowledge:

- the basic physical processes in direct and alternating current circuits, the competent use of equivalent circuits, and their mathematical modeling;
- the basic properties of electronic circuits and their elements in direct and alternating currents;
- methods of calculating electronic circuits (traditional and modern);
- studying methods and acquiring skills in modeling the characteristics of functional elements of electronic devices.

Skills:

- calculate the modes of electronic circuits on direct and alternating current;
- widely apply engineering calculations and assessments developed by predecessors;

- competently select the nominal values of circuit element parameters to obtain the desired characteristics;
- perform calculations of electronic circuits with extensive use of computer technology.

General competencies (GC)

GC 1. Ability to think abstractly, analyze, and synthesize.
GC 2. Ability to apply knowledge in practical situations.
GC 4. Knowledge and understanding of the subject area and understanding of professional activity.
GC 8. Ability to identify, pose, and solve problems.

Professional competencies (PC)

PC 4. Ability to perform computer modeling of devices, systems, and processes using universal application software packages.

Program learning results (PLR)

PLR 1. Analyze, argue, and make decisions when solving specialized problems and practical problems in telecommunications and radio engineering, which are characterized by complexity and incomplete certainty of conditions;
PLR 2. Apply the results of personal research and analysis of information to solve qualitative and quantitative problems of a similar nature in information and communication networks, telecommunications and radio engineering systems;
PLR 4. Explain the results obtained from measurements in terms of their significance and relate them to the relevant theory;
PLR 7. Correctly apply terminology in the field of telecommunications and radio engineering;
PLR 8. Describe the principles and procedures used in telecommunications systems, information and telecommunications networks, and radio engineering;
PLR 13. Apply fundamental and applied sciences to analyze and develop processes occurring in telecommunications and radio engineering systems;
PLR 18. Find, evaluate, and use information from various sources necessary for solving professional tasks, including reproducing information through electronic search;

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

The educational component "Fundamentals of Circuit Theory" belongs to the general training cycle for specialists in the field of 172 Electronic Communications and Radio Engineering. The discipline is fundamental in the training of bachelors and is related to many other disciplines. Related disciplines include: "Fundamentals of Metrology," "General Physics." The discipline "Fundamentals of Circuit Theory" itself provides the basis for studying the discipline "Signals and Processes in Radio Engineering."

3. Contents of the academic discipline

Names of sections and topics	Number of hours				
	Total	including			
		Lectures	Practical (seminar)	Laboratory (computer practicum)	SRC
Review of sections 1, 2, and 3					
Section 1. Linear direct current circuits. Section 2. Linear alternating current circuits. Section 3. Single oscillatory circuit.	18	2	2	10	4
Calculate work (CW)	10				10
Total for section	28	2	2	10	14
Section 4. Circuit functions and four-pole networks for simple circuits					
Topic 4.1. Circuit functions of simple circuits	8	2	4		2
Topic 4.2. Passive four-pole circuits	16	8	6		2
Total for Section 4	24	10	10		4
Section 5. Analysis of transient processes using operator and time methods					
Topic 5.1. Operator method in simple circuits	24	10	6	4	4
Topic 5.2. Transient processes in circuits with switching	8	4	4		
Module test (MT) for sections 4 and 5	4		2		2
Total for section 4	36	22	22	4	10
Chapter 6. Linear electrical circuits with distributed parameters					
Topic 5.1. Long lines in harmonic mode.	22	8	8	4	2
Topic 5.2. Calculation of transient processes in a long line.	8	4	2		2
MT from section 5	4		2		2
Total for Section 5	34	12	12	4	6
Exam	30				30
Total hours	**150**	**36**	**36**	**18**	**60**

4. Teaching materials and resources

Basic literature

1. Fundamentals of Circuit Theory. Lecture Course [Electronic resource]: textbook for bachelor's degree students majoring in 172 Electronic Communications and Radio Engineering / A. V. Bulashenko. – Electronic text data (1 file: 7.27 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 418 p. (https://ela.kpi.ua/handle/123456789/67768).
2. Fundamentals of Circuit Theory: A Textbook for Higher Education Students. Part 2 / Yu. O. Koval, L. V. Hrynchenko, I. O. Milyutchenko, O. I. Rybina; edited by V. M. Shokal and V. I. Pravda. – Kharkiv: Smith Company, 2008. – 560 p.
3. Fundamentals of Circle Theory: Textbook for Students of Higher Educational Institutions. Part 1 / Yu. O. Koval, L. V. Grinchenko, I. O. Milyutchenko, O. I. Rybina; edited by V. M. Shokal and V. I. Pravda. Edited by V.M. Shokal and V.I. Pravda. – Kharkiv: Smith Company, 2008. – 432 p.
4. Fundamentals of Circuit Theory. Laboratory Practicum. [Electronic resource]: textbook for students majoring in 172 Electronic Communications and Radio Engineering / A. V. Bulashenko, M. F. Mkhayan; Igor Sikorsky KPI. – Electronic text data (1 file, 2.1 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 66 p. (https://ela.kpi.ua/handle/123456789/54223).
5. Fundamentals of Circuit Theory. Collection of problems [Electronic resource]: textbook for students majoring in 172 Electronic Communications and Radio Engineering / A. V. Bulashenko; Igor Sikorsky Kyiv Polytechnic Institute. – 2nd ed., revised and supplemented. – Electronic text data (1 file, 4.9 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2024. – 180 p. (https://ela.kpi.ua/handle/123456789/67656).
6. Fundamentals of Circuit Theory. Recommendations for Calculations [Electronic resource]: textbook for students majoring in 172 Electronic Communications and Radio Engineering / A. V. Bulashenko; Igor Sikorsky Kyiv Polytechnic Institute. – Electronic text data (1 file, 2.61 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 80 p. (https://ela.kpi.ua/handle/123456789/54610)
7. Fundamentals of circuit theory. Calculation of circuit functions, four-pole circuits, and transient processes in simple circuits. Practical exercises. [Electronic resource]: textbook for students majoring in 172 Electronic Communications and Radio Engineering / A. V. Bulashenko. – Electronic text data (1 file, 2.81 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2019. – 65 p.
8. Fundamentals of circuit theory. Calculation of long lines. Practical exercises. [Electronic resource]: textbook for students majoring in 172 Electronic Communications and Radio Engineering / A. V. Bulashenko; Igor Sikorsky KPI. – Electronic text data (1 file 1.66 MB). – Kyiv: KPI named after Igor Sikorsky, 2023. – 47 p. (https://ela.kpi.ua/handle/123456789/55122).
9. Fundamentals of Theory and Computer Modeling of Electronic Circuits: Textbook [Electronic resource]: textbook for students majoring in 172 Telecommunications and Radio Engineering / V. D. Stashuk, A. V. Bulashenko; Igor Sikorsky KPI. – Electronic text data (1 file, 6.58 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2019. – 400 p. (https://ela.kpi.ua/handle/123456789/30984).

Supplementary literature

1. Samkov O.V., Koval V.V., Zaitsev G.F. Fundamentals of Electrical Circuit Theory. Textbook: Edited by Samkov O.V. – Kyiv: Institute of Electrodynamics of the National Academy of Sciences of Ukraine. – 2023. – 513 p.
2. Fundamentals of Electronic Circuit Theory: Textbook / Edited by P.G. Stakhiv, Doctor of Technical Sciences, Professor. – Lviv: Magnolia 2006, 2025. – 296 p.
3. Baidak Yu.V. Fundamentals of Circuit Theory. Textbook. – Kyiv: Vyshcha Shkola: Slovo, 2009. – 271 p.
4. Gumen M.B. Fundamentals of Electrical Circuit Theory. In 3 volumes. Vol. 1. Analysis of Linear Electrical Circuits. Time Domain: Textbook. / M.B. Gumen, A.M. Gurzhiy, V.M. Spivak; Edited by M.B. Gumen. – Kyiv: Vyshcha Shkola, 2003. – 399 p.
5. Gumen M.B. Fundamentals of Electrical Circuit Theory. In 3 volumes. Vol. 2. Analysis of Linear Electrical Circuits. Frequency Domain: Textbook. / M.B. Gumen, A.M. Gurzhiy, V.M. Spivak; Edited by M.B. Gumen. – Kyiv: Vyshcha Shkola, 2004. – 358 p.
6. Theoretical Foundations of Electrical Engineering: Textbook: in 3 volumes. / Edited by I.M. Chyzenko, V.S. Boiko. – Kyiv: IVC "Polytechnika Publishing House," 2004. – Vol. 1: Steady State of Linear Electrical Circuits with Concentrated Parameters. – 272 p.
7. Theoretical Foundations of Electrical Engineering: Textbook: in 3 volumes / edited by I. M. Chyzenko, V. S. Boiko. - Kyiv: IVC Polytechnika Publishing House, 2008. - Vol. 2. Transient processes in linear electrical circuits, nonlinear electrical and magnetic circuits. - 224 p.
8. Theoretical Foundations of Electrical Engineering: Textbook: in 3 volumes / V.S. Boiko, Yu.F. Vydolob, I.A. Kurylo, et al. – Kyiv: IVC "Polytechnika Publishing House," 2013. – Vol. 3. Electrical circuits with distributed parameters. Theory of electromagnetic fields. – 224 p.
9. Theoretical Fundamentals of Electrical Engineering. Steady-state modes of linear electrical circuits with concentrated parameters [Electronic resource]: textbook for bachelors majoring in 141 "Electric Power Engineering, Electrical Engineering, and Electromechanics" / comp.: Yu. V. Peretyatko, Ye. O. Trotsenko, M. A. Shcherba. – Electronic text data (1 file: 6.21 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2025. – 227 p.
10. Trembach R.B. Theory of Electrical and Magnetic Circuits. Textbook/ R.B. Trembach – Ternopil: TNEU, 2015 – 263 p.

Educational content

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

Lectures

Class number	Lecture content	Number of hours
1	The concept of an operator circuit function (CF), types of CFs and their application (basic provisions). Determination of circuit functions using a resistance matrix. Determination of circuit functions using a conductance matrix.	2
2	Concept of four-pole circuits. Passive four-pole circuits. Basic definitions and classification. Four-pole parameter systems, their types.	2
3	Equivalent circuits of Z-parameters and their physical meaning. Equivalent circuits of Y-parameters and their physical meaning. Equivalent circuits of h-parameters and their physical meaning. Equivalent circuits of A-parameters and their physical meaning.	2
4	Relationship between the parameters of a four-terminal network. Connection diagrams for four-terminal networks. Series connection of four-terminal networks. Parallel connection of four-terminal networks. Series-parallel connection of four-pole circuits. Parallel-series connection of four-pole circuits. Cascade connection of four-pole circuits.	2
5	The concept of a transient process, commutation. Currents and voltages on inductance and capacitance. Commutation laws and their proof. Consequences of commutation laws. The Heaviside function, its properties and use. Dirac function, its properties and use.	2
6	Direct and inverse Laplace transforms. Laplace transform and its properties. Operator circuits for passive and active circuit elements. Ohm's and Kirchhoff's laws in operator form. Operator source transforms. Laplace transforms of some typical functions. Table of originals and images.	2
7	Decomposition theorem. Finding the original from the image. Calculation of function residues at special points in the case of simple roots, in the case of multiple roots, and in the case of complex-conjugate roots. Examples of use.	2
8	Concepts of transient and impulse characteristics. Calculation of time characteristics. Relationship between impulse and transient characteristics. Time method of analysis of transient processes. Concept of function convolution. Duhamel integral. RC circuit response to a P-shaped voltage impulse.	2
9	Classical method of transient process analysis. Concepts of free and forced modes. Method for finding constants. General method of calculation using the classical method. Transient processes in series RL and RC circuits under constant voltage. The concept of circuit time constant.	2
10	Basic definitions, types of long lines. Primary parameters. Telegraph equations and their solution for harmonic current in steady state.	2
11	Analysis of transmission equations: incident and reflected waves, wavelength, phase velocity, reflection coefficient. General approach for studying the distribution of voltage and current amplitudes along the line at different load resistances. Secondary parameters: amplitude coefficient, phase coefficient, wave resistance.	2
12	Equations of a long line in hyperbolic functions and their appearance for different modes. Line as a lumped transmission line. Wave processes in a line. Line without distortion and loss. Line loaded on wave impedance	2
13	Steady wave mode. Investigation of a line without losses at no load and short circuit: distribution of amplitudes, phases, and input resistance along the line. Standing waves. Line loaded with reactive resistance.	2
14	Mixed wave mode. Line loaded with active resistance. Distribution of amplitudes, phases, input resistance along the line. Mixed waves. KBH and KSH. Line loaded with complex resistance.	2
15	Methods of matching the line to the load. Ideal transformer. Quarter-wave transformer. Reactive loops.	2
16	Transient processes in long lines. General approach to studying TP in a long line. Telegraph equations in operator form, their Solution and analysis of the solution: case $Z_H=Z_{XB}$, condition of transmission without distortion. Transient processes in a long line when $Z_H \neq Z_{XB}$. Multiple reflections. Diagram for finding the reflected wave (Petersen's rule).	2
17	Connection of an open and short-circuited line to a constant voltage.	2
18	Methods for solving Olympiad problems in the discipline "Fundamentals of Circuit Theory"	2

Practical classes

The main objectives of the practical classes are to learn practical methods for solving basic problems in the analysis of radio- electronic devices using specific examples, to reinforce theoretical knowledge and apply it to research work, and to learn how to use computing technology competently. During practical classes, problems are solved according to the collection of problems [5]. Examples of solved problems can be found in manuals [7], [8].

Class number	Practical class content	Number of hours

1	Calculation of circuits using Kirchhoff's laws, the principle of superposition (overlay), the equivalent generator method, and the loop current method. **Classroom work**: 1.11(a); 1.27(c); 1.49(a); Distribution of CW variants (one variant in three parts). Example of CW variant, Part 1: Simplification of the circuit and calculation of the circuit using the contour current method (CCM). **Homework HW-01**: calculate the CW circuit, Part 1 according to the option: Simplify the circuit and calculate its CC [2, Assignment options on pages 7-11, example on pages 22-26].	2
2	Calculation of circuit functions of simple circuits **Classroom work**: 4.1(a), 4.3(a), 4.4(c); 4.5(a), 4.6(a). Example of performing option CW, Part 1: Calculate the circuit using the Node Voltage Method (NVM). **Homework HW-02**: 4.1(b), 4.3(b), 4.4(d), 4.5(b), 4.6(b); CW, Part 1. Calculation of the circuit diagram using the KVT [2, example on pp. 27-30].	2
3	Calculation of circuit functions of complex circuits **Classroom work**: 4.7(a), 4.8(a), 4.10(a), 4.11(a), 4.23(a); Example of CW execution, Part 1. Calculation of a circuit using the equivalent generator method (EGM). **Homework HW-03**: 4.7(b), 4.8(b), 4.10(b), 4.11(c); 4.23(b); CW, Part 1. Calculation of a circuit diagram using EGM at [2, example on pages 31-35].	2
4	Calculation of simple four-pole circuits **Classroom work**: 4.12(a), 4.13(a), 4.15(a); 4.16(a), 4.17(a), 4.18(a); Example of performing option CW, Part 1: Calculation of the initial circuit and balance in the initial circuit. **Homework HW-04**: 4.12(b), 4.14(a), 4.15(b), 4.16(b), 4.17(b), 4.18(b). CW, Part 1. Calculation of the initial circuit diagram [2, example on pages 41-44].	2
5	Calculation of complex four-pole circuits **Classroom work**: 4.19(a), 4.20(a), 4.21(a), 4.26, 4.29; **Homework HW-05**: 4.19(b), 4.20(b,c); 4.21(b), 4.27, 4.30.	2
6	Calculation of simple circuits using the operator method **Classwork**: 5.1(a), 5.2(a), 5.3(a); 5.4(a), 5.5(e), 5.6(a); **Homework HW-06**: 5.1(a), 5.2(b), 5.3(b), 5.4(b), 5.5(g), 5.6(b).	2
7	Calculation of time characteristics of simple circuits using the operator method **Classroom work**: 5.7(a,b,e); 5.8(a,b,e), 5.9(a); **Homework HW-07**: 5.7(c,d,g), 5.8(c,d,g) 5.9(b).	2
8	Calculation of time characteristics of complex circuits using the operator method **Classroom work**: 5.10(a), 5.11(a), 5.12, 5.13(a), 5.14(a); **Homework HW-08**: 5.10(b), 5.11(b); 5.13(b), 5.14(b).	2
9	Calculation of transient processes in circuits with switching using the operator method **Classroom work**: 5.15(a), 5.16(a), 5.17(a); 5.18(a), 5.19; **Homework HW-09**: 5.15(b,c), 5.16(b), 5.17(b); 5.18(c,d).	2
10	Calculation of transient processes in complex circuits with switching using the operator method **Classroom work**: 5.20, 5.21, 5.23, 5.25, 5.27; **Homework HW-10**: 5.24.	2
11	Calculation of complex problems on circuit functions, transient processes, and transient processes **Classroom work**: Test MT-4. Option-1; 4.24, 4.30, 5.22, 5.26(a); **Homework HW-11**: Test MT-4: Option-2, 3.; 4.22, 5.26(b).	2
12	MT-4(1). Schematic functions, four-pole networks, and the operator method **Classwork**: Write MT-4 during class; **Homework HW-12**: Complete CW, Part 3. Calculate a single circuit according to the assignment option.	2
13	Calculation of simple distributions in long lines **Classwork**: 6.1, 6.4; 6.5; 6.6, 6.9(a); **Homework HW-13**: 6.2, 6.3; 6.7; 6.8, 6.9(b).	2
14	Calculation of long lines with reactive and complex loads **Classroom work**: 6.10(a), 6.11(a); 6.12(a); 6.13(a), 6.14; **Homework HW-14**: 6.10(b), 6.11(b), 6.12(b), 6.13(b). 6.15(a,b).	2
15	Calculation of quarter-wave transformers **Classroom work**: 6.16, 6.18, 6.19; 6.20(a); **Homework HW-15**: 6.17(a,b), 6.20(b).	2
16	Calculation of long line matching modes **Classroom work**: 6.21(a), 6.22(a); 6.24; 6.26; **Homework HW-16**: 6.21(b), 6.22(b), 6.25; 6.23, 6.27.	2
17	Calculation of transient processes in long lines **Classwork**: 6.28(a, b), 6.30(a, b), 6.31(a); **Homework HW-17**: 6.28(d), 6.30(b,d), 6.31(b), Test version MT-2.	2
18	MT-5(2). Long lines **Classwork**: Write MT-5 during class according to the assignment option; **Homework HW-18**: correct mistakes.	2

Laboratory work

The main objectives of the laboratory course are to apply the acquired knowledge in practice and to develop skills for independent work with equipment.
The work is carried out in accordance with the laboratory work manual [4]. The topics of the laboratory work are listed below:

No.	Name of laboratory work	Number of classroom hours
1	Basic measurements in electrical circuits.	1
2	Basic laws of electrical circuits.	2
3	Simple circuits of harmonic current.	3
4	Series oscillatory circuit.	2
5	Parallel oscillatory circuit.	2
6	Transient processes in linear circuits.	4
7	Circuits with distributed parameters.	4

6. Independent work of higher education seekers

No	Title of the topic for independent study	Number of hours of independent study (SS)
1,2,3	Section 1. Linear electric circuits of direct current. Section 2. Linear electric circuits of alternating current. Section 3. Single oscillatory circuit	6
	Performing CW	8
	Total for sections 1, 2, 3	14
4	Section 4. Circuit functions, four-pole circuits, and the operator method	10
	Determination of circuit functions using the resistance and conductance matrix	2
	Equivalent circuits of four-terminal networks.	2
	Calculation of transient processes in circuits using the operator method	2
	Preparation for laboratory work on Section 4	2
	Preparation for MT	2
5	Chapter 5. Linear electrical circuits with distributed parameters	6
	Long lines in harmonic mode.	2
	Preparation for laboratory work on Chapter 5	2
	Preparation for MT	2
	Preparation for the exam	3
	Total hours	60

Individual assignments

One calculation work (CW) is provided: "Analysis of linear circuits of direct and harmonic currents" (consisting of three sections). The main goal is to reinforce the theoretical course through practical independent work by performing specific calculations. The following tasks are performed in the CW "Analysis of linear circuits of direct and harmonic currents":

- calculation of a three-circuit direct current circuit using equivalent transformations or equivalent generator, loop currents, node voltages; checking the power balance;
- calculation of R-L-C circuits using complex amplitudes, construction of vector and time diagrams, verification of active and reactive power balance;
- engineering calculation and construction of frequency characteristics of a single oscillatory circuit. Assignments for the course are given individually to each student from [6].

.

Policy and control

7. Academic discipline policy (educational component)

Rules for attending classes (both lectures and practical/laboratory classes)
All types of classes are mandatory: lectures, practical classes, and laboratory classes. Completion of all laboratory work is mandatory. If these classes are missed, they must be made up during consultations or with other groups.
Defense of laboratory work
Laboratory work is defended on the day the laboratory work is completed. The defense takes the form of an interview. A mandatory condition for admission to the defense is the availability of a formal protocol, which contains the results of the completed laboratory work in the form of corresponding graphs and calculations or screenshots of measurements in the case of remote work.
Completion and defense of the calculation work (CW)

As part of their independent work, students complete the CW assignment according to the option. Based on the results of the check, if the work is completed correctly, the student is assigned a date for the CW defense. The defense takes the form of an interview. Repeated CW defenses are not provided for.

Incentive and penalty points and academic integrity policy

Any form of assessment, except for laboratory work, can be replaced by incentive rating points for winning prizes (1st, 2nd, or 3rd place) in a subject-specific academic competition. Or by preparing abstracts for international scientific conferences on radio engineering in English and presenting a report at the conference: 1 abstract – 5 points (as agreed with the lecturer). Participation in the Olympiad is assessed from 0 to 5 points depending on success.

Penalty points are applied in the case of passing off someone else's work as your own, with mandatory subsequent reworking.

Deadline and resit policy

If the deadlines for submitting assignments are missed, the maximum score for the assignments is reduced by 10% for course participants.

Class attendance

Attendance at lectures, practical classes, and laboratory classes is in accordance with the Regulations on the Organization of the Educational Process at Igor Sikorsky KPI. At least once every two weeks, the instructor conducts consultations on various issues related to the credit module. During consultations, the instructor can provide assistance in studying the material of classes that students have missed for various reasons and must master on their own.

In any case, students are encouraged to attend all types of classes, as they cover theoretical material and develop the skills necessary to complete homework, laboratory work, and calculations.

Announcement of test results

The defense of the completed section of the RR takes the form of an interview with the teacher. During the defense, the student must be able to explain the results obtained and answer the main theoretical questions on the topics of the sections. The results of the defense are announced to the student in his or her presence or in remote communication and accompanied by specific comments and remarks regarding errors (remote communication via Zoom, Telegram with video and audio).

The results for the completed homework assignment are given at the end of its completion and defense, no later than the next class.

Missed tests

The result for a student who did not attend the assessment is zero. If a student misses an assessment for a valid reason, they are given the opportunity to complete it (write a module test) in the presence of the teacher. If the absence was without a valid reason, the issue of making up for it is decided with the teacher in agreement with the department management. A missed test is not counted.

regardless of the reasons for absence; in this case, the student will receive a "did not appear" mark; if they are eligible for admission to the exam, they must take the exam during an additional session.

Academic integrity

The policy and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute." For more details, see: https://kpi.ua/code.

Standards of ethical conduct

The standards of ethical conduct for students and employees are defined in Section 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute." For more information, visit: https://kpi.ua/code.

Procedure for appealing the results of control measures

Students have the opportunity to raise any issue related to the procedure for conducting and/or evaluating control measures and expect that it will be considered in accordance with predefined procedures.

Students have the right to appeal the results of assessment measures, but must provide a reasoned explanation of which criteria they disagree with in accordance with the assessment sheet and/or comments.

8. Types of assessment and the learning outcomes assessment rating system (LRS)

Assessment measures and distribution of points in the semester Rsem

Type of assessment	Explanation	Maximum score	Deadline for completion/submission
MT	**Total score for all MCRs**	**10**	
	MT-4. Circuit functions, four-pole circuits and the operator method	5	08.11.2025
	MT-5. Long lines	5.0	13.12.2025
CW	**3 parts, 5 points each**	**15**	
	CW, Part 1. Calculation of a direct current circuit	5	04.10.2025
	CW, Part 2. Calculation of a harmonic circuit current	5.0	01.11.2025
	CW, Part 3. Calculation of a single circuit	5.0	11/29/2025
Lab work	**Total score for all work**	**25**	
	Lab-1. Basic measurements in electrical circuits	-	according to schedule
	Lab-2. Basic laws of electrical circuits	5.0	according to schedule
	Lab-3. Simple harmonic current circuits	5.0	as scheduled
	Lab-4. Series oscillatory circuit	2.5	according to schedule
	Lab-5. Parallel oscillatory circuit	2.5	according to schedule
	Lab-6. Transient processes in linear circuits	5.	According to schedule
	Lab-7. Circles with distributed parameters	5.0	according to schedule
Total score for the semester		**50**	
Exam	**3 questions on the exam: theory and problems**	**50**	According to schedule
Overall score for the discipline		**100**	after the exam

MT – modular test, involves solving practical problems according to the topics of the discipline;

CW – calculation work, involves performing calculation work according to the task option and defending it in the form of an interview;
Lab work – laboratory work, involves performing laboratory work according to the task option and defending it in the form of an interview.
Topics for MT and their assessment

MT number/number of tasks	Task topics	Total score
MT-4. Schematic functions, four-pole networks, and the operator method 3 tasks	1. Calculation of circuit functions of simple circuits	5
	2. Calculation of four-pole networks of simple circuits	
	3. Calculation of simple circuits, circuits with switching using the operator method, calculation of time characteristics of the circuit.	
MT-5. Long lines 3 tasks	1. Calculation of simple distributions in a line	5
	2. Calculation of a line with reactive and complex load	
	3. Calculation of complex distributions in a line, calculation of line matching modes, calculation of transient processes in the line	

Requirements for admission to the exam:
1. Earning at least **30 points** during the semester.
2. Completion of all parts of the coursework with a positive result (at least 3 points for each separate part).
3. Completion of all laboratory work (at least 60% of the maximum score for each).
4. Completion of all MT with a positive result (at least 3 points for each).
5. Possession of a notebook with solutions to practical problems and a notebook with lecture notes.

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

Number of points	*Grade*
10	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)

Questions for exam preparation.

1. Concepts of circuit functions and their types. Classification of circuit functions.
2. Determination of circuit functions by the matrix of resistances and conductances.
3. Concept of four-pole circuits and their classification. Operating modes of four-pole circuits.
4. Four-terminal network parameter systems.
5. Relationship between four-terminal network parameters (between Y and Z; between Y and h).
6. Four-terminal circuit parameter substitution schemes and their physical meaning (Z-parameters, Y-parameters, h-parameters, A-parameters; F-parameters).
7. Circuits for connecting four-pole circuits, determining their general parameters.
8. The concept of commutation and transient processes. Commutation laws and their proofs. Consequences of commutation laws.
9. Operator method: Laplace transform and basic properties of Laplace.
10. Dirac and Heaviside functions and their properties.
11. Operator circuits for passive and active elements.
12. Ohm's and Kirchhoff's laws in operator form.
13. Finding the original. Decomposition theorem for simple roots and complex roots.
14. The classical method of calculating transient processes. General method of calculating circuits using the classical method. The concepts of free and forced modes.
15. Connecting RL and RC circuits to a constant voltage. The concept of circuit time constant.
16. Time characteristics of a circuit (impulse and transient) and their calculation.
17. Time method for calculating transient processes. Duhamel's integral.
18. Circuits with distributed parameters and their classification. Telegraph equations and their derivation.
19. Primary and secondary parameters of a long line.

20. Solution of telegraph equations from the beginning of the line. Analysis of transmission equations: incident and reflected waves. Wavelength and phase velocity
21. Solution of telegraph equations from the end of the line: analysis of transmission equations from the end of the line.
22. Construction of voltage and current distribution amplitudes along the line. Determination of the distance to the first minimum and maximum.
23. Line equation as a four-pole.
24. Running wave mode: line without distortion and loss and line loaded with wave resistance.
25. Steady wave mode of a lossless line: no-load and short-circuit modes, line loaded with reactive impedance.
26. Mixed wave mode.
27. Methods of matching the line to the load.
28. Transient processes in lines.

Work program for the academic discipline (syllabus):

Compiled by senior lecturer, candidate of technical sciences, Andriy Vasylovych Bulashenko

Approved by the Department of Radio Engineering (Minutes No. 8/2025 dated 06/25/2025)

Approved by the Methodological Commission of the RTF Faculty (Minutes No. 6/2025 dated 06/26/2025)