СӘТБАЕВ УНИВЕРСИТЕТІ

SATBAYEV UNIVERSITY

Institute of automation and information technologies

Department Electronics, telecommunications and space technologies

APPROVED by Institute Director
Kalpeyeva Zh.B.
«___» _____2024.

SYLLABUS
ELCS423-THEORETICAL FOUNDATIONS OF ELECTRICAL ENGINEERING I

6B07101-Power engineering
5 credits (2/1/0/2)

Semester: *autumn*, 2024-2025academic year

Almaty 2024

Information about instructor:

1.1 Lecturer:

Dosbayev Zhandos Makhsutuly, senior lecturer

Learning format – full-time

office: IM&E, 169 Office-hours: Monday 11:00-12:00

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1.2 Instructor(s), conducting the practical/laboratory work

Dosbayev Zhandos Makhsutuly, senior lecturer

office: office: IM&E, 169 Office-hours: Monday 11:00-12:00

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2 The purpose and the objective of the course

The purpose: The course "Theoretical Foundations of Electrical Engineering I" aims to provide students with a solid understanding of the fundamental principles and concepts that form the basis of electrical engineering. The primary purposes of this course are introducing students to essential electrical concepts such as voltage, current, resistance, capacitance, inductance, power, and energy and it establishes a foundation for understanding how electrical circuits operate and how they are analyzed; teach students various methods for analyzing electrical circuits, including Ohm's law, Kirchhoff's laws. Provide a comprehensive understanding of both direct current (DC) and alternating current (AC) circuits.

The objective:

- Introduce students to essential electrical concepts such as voltage, current, resistance, capacitance, inductance, power, and energy;

- each students various methods for analyzing electrical circuits, including Ohm's law, Kirchhoff's laws (both current and voltage laws);

- Provide an understanding of direct current (DC) and alternating current (AC) circuits. Students learn the differences between AC and DC circuits, the behavior of circuit components in each type, and how to analyze circuits with time-varying signals.

- Equip students with mathematical tools and methods required for solving electrical engineering problems. This includes complex numbers, phasor analysis, differential equations, and other mathematical techniques used in circuit analysis.

- Familiarize students with the different types of electrical components such

as resistors, capacitors, inductors, transformers, and operational amplifiers, along with their characteristics and applications in electrical circuits.

- Develop analytical and problem-solving skills specific to electrical engineering by applying theoretical knowledge to practical problems, designing circuits, and predicting their behavior.

3 Course Description:

The course is intended for students of the educational program «6B07101-Power engineering». "Theoretical Foundations of Electrical Engineering I" is an introductory course that provides a comprehensive overview of the fundamental principles, concepts, and mathematical techniques that are essential for understanding and analyzing electrical circuits and systems. This course is designed for students pursuing a degree in electrical engineering or related fields, and it establishes a strong foundation for more advanced studies in the discipline. By the end of this course, students will have a thorough understanding of the core concepts of electrical engineering and the tools needed to analyze both simple and complex electrical circuits. The course also prepares students for further studies in advanced electrical engineering topics such as electronics, electromagnetics, and control systems.

4. Learning outcomes

Upon completion of the course, the student will

know:

- The basic electrical quantities such as voltage, current, resistance, capacitance, inductance, power.
- Key electrical laws, including Ohm's Law, Kirchhoff's Current Law (KCL), and Kirchhoff's Voltage Law (KVL), as well as the ability to apply these laws to analyze both DC and AC circuits.
- Techniques such as mesh and nodal analysis, superposition, Thevenin's and Norton's theorems, and maximum power transfer to solve complex electrical circuits.

be able to:

- Calculate and analyze power in both DC and AC circuits, including active, reactive, and apparent power, and the concept of power factor in AC systems.
- Techniques such as mesh and nodal analysis, superposition, and maximum power transfer to solve complex electrical circuits.

Have skills:

- The use of complex numbers, phasors, differential equations, and other mathematical tools to model and solve electrical engineering problems.
- Basic laboratory skills, including how to use electrical measurement instruments (such as multimeters and oscilloscopes) and perform experiments to validate theoretical concepts.

-Enhanced analytical and problem-solving skills to tackle a wide range of electrical engineering challenges, from circuit design to troubleshooting.

5 Calendar and thematic plan

Week	Topic of the lecture	Topic of the laboratory work	SIS/TSIS	Reference to the literature	Deadline
1	Linear DC Electrical Circuits. Basic concepts and definitions. Ohm's and Kirchhoff's Laws. Application of Ohm's and Kirchhoff's Laws for calculating electrical circuits. Potential diagrams.	Introduction to software and the test bench.		[1] 79-88 p.; [2] 187-193 p.; [4] 84-88 p.	
2	Equivalent transformations of electrical circuits. Power balance. Operating modes of power sources.	№1 Laboratory work. Analysis of a branched electrical circuit based on Ohm's law and Kirchhoff's laws.		[1] 131-159 p.; [2] 49-57 , 66-69 p.	
3	Methods for calculating complex electrical circuits: Superposition method, mesh current method, nodal potential method.	№1 Laboratory work. Analysis of a branched electrical circuit based on Ohm's law and Kirchhoff's laws.	**SIS 1.** Calculation of DC electrical circuits using of Ohm's and Kirchhoff's Laws	[1] 27-35 p.; [6] 12 – 69 p.	4 week
4	Methods for calculating complex electrical circuits: Nodal voltage method, equivalent generator method.	№2 Laboratory work. Investigation of linear electrical circuits using the method of superposition."	**TSIS 1.** Linear DC Electrical Circuits. Basic concepts and definitions.	[1] 161 – 196 p.; [6] 297-325 p.	
5	Generation of sinusoidal current. Structure of a synchronous machine. Operation of a synchronous machine in generator mode. Main characteristics of sinusoidal current.	№2 Laboratory work. Investigation of linear electrical circuits using the method of superposition."		[1] 128-135 p.; [2] 158-166 p. [3] 58-66 p. [4] 169 - 188 p.	
6	Elements of AC electrical circuits with sinusoidal current.	№3 Laboratory work.Electrical circuits with sinusoidal current sources connected in series.	**SIS 2.** Calculation of DC electrical circuits using mesh current method, nodal potential method.	[1] 191-201 p.;	7 week

Week	Topic of the lecture	Topic of the laboratory work	SIS/TSIS	Reference to the literature	Deadline
7	Ohm's Law for an AC circuit with sinusoidal current. Power in an alternating sinusoidal current circuit. Voltage resonance.	№3 Laboratory work.Electrical circuits with sinusoidal current sources connected in series.	**TSIS 2.** Methods for calculating complex electrical circuits	[1] 202-227 p.;	
8	Parallel connection of loads. Graphical-analytical method for calculating electrical circuits. Conductances in AC circuits. Ohm's Law in terms of conductances. Current resonance.	№4 Laboratory work. Study of Linear DC Electrical Circuits.		[1] 178-192 p.; [2] 122-149 p. [3] 158-166 p.	
	The mid-term control-The first attestation				Week 8
9	Analytical representation of vectors. Addition and subtraction of sinusoidal functions. Ohm's Law in complex form.	№5 Laboratory work. Study of a non-branched sinusoidal current circuit. Voltage resonance.		[1] 161 – 196 p.; [2] 197-225 стр.	
10	Power in AC Circuits: Real, Reactive, and Apparent Power	№5 Laboratory work. Study of a non-branched sinusoidal current circuit. Voltage resonance.	**SIS 3.** Ohm's Law in complex form for an AC circuit with sinusoidal current	[1]97-103 p. [2]126-157 p. [5]131-137 стр.	11 week
11	Generation of a three-phase EMF system. Basic concepts and definitions of three-phase circuits.	№6 Laboratory work. Study of a branched sinusoidal current circuit. Current resonance.	**TSIS 3.** Voltage and current resonance.	[2]84-96 p. [3]150-162 p. [4]270-288 p.	
12	Calculation of three-phase loads connected in "star" (wye) and "delta" configurations.	№6 Laboratory work. Study of a branched sinusoidal current circuit. Current resonance.		[3]145-168 p. [5]354-366 p.	
13	Magnetic Circuits and Electromagnetic Induction	№7 Laboratory work. Study of a three-phase electrical circuit with electrical loads connected in a star configuration	**SIS 4.** Calculation of DC electrical circuits using mesh current method, nodal potential method.	[3]154-180 p. [6]268-275 p.	14 week
14	Non-harmonic EMFs, voltages, and currents.	№7 Laboratory work. Study of a three-phase electrical circuit with electrical loads connected in a star	**TSIS 4.** Calculation of three-phase loads	[2]140-172 p. [4]154-166 p.	

Week	Topic of the lecture	Topic of the laboratory work	SIS/TSIS	Reference to the literature	Deadline
		configuration			
15	Practical Applications of Electrical Theory	№7 Laboratory work. Study of AC Electrical Circuits.		[2]184-196 p. [3]150-162 p.	
	The second final attestation				Week 15
	Examination				Based on the schedule

6 Literature

Required	Supplementary
[1] Engineering circuit analysis / William H. Hayt, Jr., Jack E. Kemmerly, Steven M. Durbin. — 8th ed. p.	[4] Немцов М.В. Электротехника. В 2-х кн. - М.: Изд.центр Академия. 2020
[2] Теоретические основы электротехники. Ч.1.Нейман Л.Р., Демирчан К. С.Л.: Энергоиздат, 2020.	[5] Электротехника, электроника и автоматизация. О.Н.Чурляева. ФГБОУ ВО Саратовский ГАУ. - Саратов, 2016.
[3] Теоретические основы радиотехники. Сигналы. А. С. Нечаев. Издательство ЛАНЬ. 2021. - 213 с.	[6] А. Радиотехнические цепи и сигналы. (Учебное пособие).- С. Пб.: Изд-во «Свое Издательство», 2015.- 340 с.

** The literature is available in the electronic resources of the library.*

*** The main literature should not be older than 10 years.*

~ The literature is available on the teacher's learning portal.

7 Competence framework

Learning Descriptors	Competences				
	Natural science and theoretical worldview	Socio-personal and civil	General engineering professional	Cross-cultural and communicative	Special-professional
Knowledge and comprehension	+		+		+
Application of knowledge and comprehension			+		+
Expression of judgments and analysis of actions		+		+	
Communication and creative abilities		+		+	+
Self-learning and digital skills			+		+

8 Schedule of submission of mandatory assignments

# s/n	Type of control	Max score of the week	Weeks															Total max points
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	Activeness in lecture discussions			0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5		6
2	Task execution (TSIS)					2			2				2		2			8
3	Student Independent Study (SIS)					5			5				5		5			20
4	Performing the practical tasks																	
5	Performing the laboratory tasks				3		3		3			3		3		3		12
6	1st attestation								7									7
7	2nd final attestation															7		7
8	Final exam*																	40
	In total																	**100**

9 Evaluation rating and possible final versions of assessments according to criteria

Letter grade	GPA	scores	Criteria
A	4	95-100	Shows the highest standards of knowledge, exceeding the volume of the course taught
A-	3,67	90-94	Meets the highest standards of knowledge
B+	3,33	85-89	Very good and meets high standards of knowledge
B	3	80-84	Good and meets most high standards of knowledge
B-	2,67	75-79	More than sufficient knowledge approaching high standards
C+	2,33	70-74	Sufficient knowledge that meets the general standards
C	2	65-69	Satisfies and conforms to most common knowledge standards
C-	1,67	60-64	Satisfies, but according to some knowledge does not meet the standards
D+	1,33	55-59	Minimally satisfying, but does not meet the standards for a large range of knowledge
D	1	50-54	Minimally satisfactory passing score with questionable compliance with standards
FX	0,5	25-49	Temporary assessment: Unsatisfactory low indicators, retake of the exam is required
F	0	0-24	Didn't try to master the discipline. It is also exposed when a student tries to get a grade on the exam by cheating

10 Evaluation criteria

Each work except tests is evaluated according to 4 criteria:

– precision and accuracy (A) – 30% (how accurately and neatly the work is calculated);

– inventiveness and creativity (T) – 30% (how and in what way the work is presented);

– completeness and maturity (H) – 40% (how profoundly, logically and

structurally the work is solved);

originality (O) – a special coefficient of 1.0, 0.5 or 0 is used.

Criteria	Excellent (0.9-1.0)	Good (0.7-0.9)	Satisfactory (0.4-0.7)	Unsatisfactory (0-0.4)
precision and accuracy	0,3	0,24	0,15	0,06
inventiveness and creativity	0,3	0,24	0,15	0,06
completeness and maturity	0,4	0,32	0,2	0,08
originality	0	0		0

The overall score will be calculated due to the formula:

$$Score = (A + T + 3) \times O$$

11 Late submission policy

The student must come prepared for lectures and practical (laboratory) classes. Timely protection and full performance of all types of work (practical and independent) is required. The student should not be late and miss classes, be punctual and mandatory. It is planned to reduce the maximum score by 10% for untimely work. If you are forced to skip the intermediate certification for good reasons, you should warn the teacher in advance before it, so that you can pass the boundary control in advance. Skipping an exam for a disrespectful reason deprives you of the right to take it. If you miss the exam for a good reason, a special permit is issued and the date, time and place of the exam are assigned.

12 Academic Conduct and Ethics Policy

Be tolerant, respect the opinions of others. Formulate objections in the correct form. Plagiarism and other forms of dishonest work are unacceptable. Prompting and cheating during exams, passing the exam for another student are unacceptable. A student caught falsifying any course information will receive a final "F" grade.

Activeness in lectures and practical classes is mandatory and is one of the components of your final score / assessment. Many theoretical questions supporting the lecture material will be presented only at lectures. Therefore, skipping a class can affect your academic performance and final grade. However, attending classes in itself does not mean an increase in points. Your constant active participation in the classes is necessary. A mandatory requirement of the course is to prepare for each lesson. It is necessary to review the specified sections of the textbook and additional material not only in preparation for practical classes, but also before attending the corresponding lecture. Such training will facilitate your perception of new material and will contribute to your active acquisition of knowledge within the walls of the university.

Support: For advice on implementing the independent work, their submission and defending, as well as for additional information on the material covered and all other questions arising on the course being read, contact the teacher during their office hours or via electronic means of communication during working hours.

During the process of learning:

Mandatory participation in training sessions according to the schedule, which determines the readiness for the lesson. In case of absence, the student is obliged to notify the teacher within a day and explain the plan for self-study of the study material:

- mandatory reading of the presented materials before the lesson;
- submission of tasks on time;
- 20% non-participation in the audience (for a valid reason with the supporting documents) - rating "F (Fail)";
- plagiarism and cheating during the execution of the task are not allowed;
- mandatory use of electronic gadgets in the classroom that is welcome, but it is unacceptable to use them in the exam.

Any appearance of academic dishonesty, academic deception and corruption in any form are unacceptable within the framework of the sunject. The organizer of such actions (the teacher, students or third parties on their behalf) are fully responsible for violating the laws of the Republic of Kazakhstan.

In the beginning of the academic term, students need to familiarize themselves with the contents of the syllabus F KazNRTU 401-03. The journal of familiarizing.

Considered at the meeting of the ET&ST Department
Minutes №1, 20th of august, 2024

Head of the department _____ **Tashtay Y.**

Syllabus designer: _____ **Dosbayev Zh.**