SYLLABUS OF THE COURSE
«FUNDAMENTALS OF ELECTRIC DRIVES»

Academic degree	Bachelor
Specialty	141 Electrical energetics, electrical engineering and electromechanics
Academic program	Electrical energetics, electrical engineering and electromechanics
Period of study	4 semester (7, 8 terms)
Total workload	5 credits ECTS (150 hours)
Classroom workload:	
lectures:	2 hours
laboratory works:	1 hour
practical	1 hour (8 term)
Language of study	English

Course page in E-learning platform of DniproTech:
https://do.nmu.org.ua/course/view.php?id=3174

Teaching Department Electric drive

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1. About this course

The subject of the course is an automated electric drive, which is the main force of automation of industrial installations and technological complexes. The most attention in the course is given a reasonable choice of energy -saving electric drive, methods of its design, considering the requirements of technology and modes of operation, as well as the calculation and selection of the main power elements of the electric drive, as well as the calculation of static characteristics of the electric drive and the study of mechanical transient processes.

Discipline is devoted to the study of electromechanical properties and modes of operation of electromechanical systems with rigid mechanical connections; electromechanical transients, systems with DC and AC motors; adjustment of coordinates of the electromechanical system.

Understanding the tasks that are solved by the electric drive will allow specialists to form views on the process of development and improvement of systems of managed electrical energy into mechanical motion and progressive means of control of the movement of electromechanical systems in order to use energy resources in all industries.

2. Aim and objectives

The purpose of the discipline is to form competencies in the construction, principle of action and analysis of processes in automated electric drives.

Course objectives:

- to acquaint higher education applicants with the appointment, the overall construction of the automated actuator system and the elemental base of the automatic control of the current force;
- to get acquainted with the main trends and features of the release of the theory and practice of modern electric drive;
- study the assembly scheme of the mechanical part of the actuator with rigid mechanical connections;
- to study the dynamic properties of the mechanical part of the electric drive without taking into account elastic connections and gaps;
- to study the dynamic properties of the engine of independent excitation, structural circuits and the influence of electromagnetic energy on the dynamics of the electric actuator;
- study electromechanical properties and modes of operation of asynchronous engines;
- to study the basic methods of adjusting the current, moment and position of the electric drive with DC and AC motors;
- study the principles of construction of automated control systems;
- to study the direction of reduction of electricity loss and to calculate the power of the engine.

3. Learning outcomes

Disciplinary learning outcomes:

- to determine the principles of construction and functioning of elements of control systems of electromechanical complexes;
- evaluate the parameters of electromechanical equipment and corresponding complexes and systems and develop measures to increase their energy efficiency and reliability;
- demonstrate skills in working with modern equipment, as well as performing calculations of modes of operation of electromechanical equipment, corresponding complexes and systems;
- invent new ways to solve the problem of economic transformation and use of electricity.

4. Course structure

LECTURES

1 Basics of electric drive mechanics

1.1 The main trends and features of the development of the theory and practice of modern electric drive. The purpose and commitment of the discipline, its content and connection with related disciplines.
1.2 Kinematical calculation circuits of the mechanical part of the electric drive.
1.3 Equation of movement with unchanged and variable moments of inertia.

2 Electromechanical and mechanical characteristics of engines

2.1 Electromechanical properties, characteristics, and modes of operation of DC motors.
2.2 Characteristics of engines in brake modes.
2.3 Characteristics and brake modes of the sequential excitation engine.
2.4 Electromechanical properties and characteristics of asynchronous motors.
2.5 Characteristics of the asynchronous engine in brake modes.
2.6 Characteristics and modes of operation of synchronous engines.

3 Dynamics of electromechanical systems

3.1 Transitional processes of electric drive with a linear mechanical characteristic (start, reverse, braking).
3.2 Formation of transitional processes in controlled systems - engine.

4 Electric drive coordinates

4.1 Rheostatical control of DC and AC motors.
4.2 Parametric means of adjusting the speed of asynchronous engines.
4.3 Typical structures of the electric drive when driving several coordinates.
4.4 Features of current and speed adjustment in the system VSC-DCV converter.
4.5 Features of current and speed adjustment in the GD system
4.6 Features of current and speed adjustment in the system frequency converter-asynchronous motor.
4.7 Features of current adjustment and speed of synchronous motors.

5 Energetics of Electric drive

5.1 Electric drive energy. Energy loss in established and transitional modes.

5.2 Energy efficiency and indicators of regulated electric drive.

5.3 Energy characteristics of managed rectifiers.

5.4 The impact of managed rectifiers on the supply network and its reduction means.

6 Calculation of electric drive power

6.1 Classification of modes of operation of electric motors.

6.2 Construction of a load diagram.

6.3 Methods for selecting and checking the engine by heating.

LABORATORY WORK

1. Experimental determination of the moment of inertia.
2. Investigation of mechanical characteristics of the DC motor of independent excitation.
3. Investigation of mechanical characteristics of the DC motor of successive excitation.
4. Investigation of the mechanical characteristics of the asynchronous engine.
5. Investigation of the characteristics of the GM system.
6. Investigation of the characteristics of the TC-M system.

PRACTICAL TRAINING

1. Running moments of resistance, moments of inertia and masses to the speed of the engine
2. Running moments of resistance and inertia to the moving mass
3. Construction of mechanical characteristics of the DC motor in engine mode and brake mode
4. Construction of mechanical characteristics of the asynchronous motor in engine mode and brake mode
5. Calculation of mechanical transitional processes

5. Hardware and / or software

Technical means of training.

E-platform MOODLE, MS Teams.

6. System of evaluation and requirements

6.1. The academic achievements of higher education students based on the results of the course will be assessed on the scale below.

Rating scale	Institutional scale
90 – 100	Excellent
74-89	Good
60-73	Satisfactory

0-59	Fail

The general criteria for achieving the learning outcomes correspond to the descriptions of the 6th qualification level of the NQF.

6.2. Applicants for higher education may receive a final grade in an academic discipline based on the formative assessment of knowledge, provided that the number of points gained is at least 60 points.

The maximum rating:

Theoretical module	Laboratory module	Practical module	Bonus	**Total**
60	30	10	5	**100**

At the end of the course, the student passes an exam based on the results of the training. The maximum marks are awarded according to the table above.

The theoretical part is assessed based on the results of the control test, which contains 30 questions, each weighing 2 points (60 points in total).

6.3. Evaluation criteria for laboratory work

The laboratory part consists of six laboratory works, each worth 5 points (30 points in total). Laboratory works are performed and submitted sequentially and must be submitted before the theoretical part.

Correctly completed **laboratory work** is evaluated at 5 points, and

- **5 points** - full compliance with the essence of the work;
- **4 points** - correspondence to the essence of the work with minor deviations and inaccuracies;
- **3 points** - partial correspondence to the essence of the work without its full disclosure;
- **2 points** - there are significant errors in the work;
- **0 points** - the work is not presented or does not relate to the topic of the work.

6.4. Evaluation criteria for practical classes

The practical part consists of five practical papers, each worth 2 points (10 points in total). Practical works are performed and submitted sequentially and must be submitted before the theoretical part.

Correctly completed **practical work** is evaluated at 2 points, and

- **2 points** - full compliance with the essence of the work;
- **1 point** - partial correspondence to the essence of the work without its full disclosure;
- **0 points** - the work is not presented or does not relate to the topic of the work.

6.5 Evaluation criteria for the final work

If a higher education student has received less than 60 points in the formative academic performance or seeks to improve the grade, **a final assessment (exam)** is conducted during the session.

The **exam** is conducted in the form of a comprehensive test, which includes questions from the theoretical and practical parts of the course. The ticket consists of three theoretical open-ended tests and two practical open-ended tests (tasks), each weighing 20 points (100 points in total).
The test is available at:

- **20 points** - full compliance with the essence of the question;
- **15 points** - compliance with the essence of the question with minor deviations and inaccuracies;
- **10 points** - partial compliance with the essence of the question without its full disclosure;
- **5 points** - there are significant errors in the test;
- **0 points** - the answer is not given or is not relevant to the topic of the question.

7. Course policy

7.1. Academic Integrity Policy. The academic integrity of higher education applicants is an important condition for mastering the learning outcomes of the course and obtaining satisfactory grades in formative and summative assessments. Academic integrity is based on the condemnation of the practices of cheating (writing with the involvement of external sources of information other than those authorized for use), plagiarism (reproduction of published texts of other authors without proper attribution), fabrication (inventing data or facts used in the educational process). The policy on academic integrity is regulated by the Regulation on system of prevention and detection of plagiarism at the Dnipro University of Technology (https://www.nmu.org.ua/ua/content/activity/us_documents.pdf).

If a higher education applicant violates academic integrity (cheating, plagiarism, fabrication), the assignment is graded unsatisfactory and must be repeated. In this case, the instructor reserves the right to change the topic of the assignment.

7.2. Communication policy. Applicants for higher education must have an activated corporate university email.

All written questions to the instructors regarding the course should be sent to the university email.

7.3. Policy on retakes. Assignments that are submitted late without valid reasons will be evaluated at a lower grade. Retakes of the summative assessment are allowed with the permission of the dean's office if there are valid reasons (e.g., sick leave).

7.4. Class attendance. Attendance at classes is mandatory for full-time applicants for higher education. Valid reasons for absence from classes are illness, participation in university events, and academic mobility, which must be confirmed by documents. A higher education applicant must notify the instructor either personally or through the leader of the academic group about the absence from class and the reasons for the absence.

If a course learner is ill, it is recommended that he or she stays at home and studies in the E-learning platform of DniproTech. Learners whose health condition is unsatisfactory and may affect the health of others will be asked to leave the class (such absence will be considered as an absence due to illness).

Practical classes are not repeated; these activities cannot be completed during the consultation.

For objective reasons (e.g. international mobility), studies may take place online with the consent of the course instructor.

7.5 Evaluation appeal policy. If a higher education applicant does not agree with the evaluation of his/her knowledge, he/she may appeal the grade assigned by the instructor in a prescribed manner.

8 Recommended sources of information

Basic:

1. Електропривод: Навчальний посібник / Закладний О.М., Прокопенко В.В., Закладний О.О. – Київ: Вища школа, 2009.- 351 с.

2. Теорія електропривода: Підручник / М.Г. Попович, М.Г. Борисюк, В.А. Гаврилюк та ін.; за ред. М.Г. Поповича. –К.: Вища шк., 1993. -494 с.

3. Теорія електроприводу: Збірник задач / Булгар В.В. - Одеса: Поліграф, 2006. – 408 с.

4. Колб Ант.А., Колб А.А. Теорія електроприводу [Текст]: навч. посібник. – 2-ге вид., перероб. і доп. – Д.: Національний гірничий університет, 2011. – 565 с.

5. Колб А.А. Основи електроприводу. Методичні рекомендації до виконання лабораторних робіт для бакалаврів спеціальності 141 Електроенергетика, електротехніка та електромеханіка / А.А. Колб, Г.Г. Дяченко, О.В. Садовой; Нац. техн. ун–т. «Дніпровська політехніка». – Д.: НТУ «ДП», 2021. – 50 с.

6. Колб А.А. Основи електроприводу. Методичні рекомендації до практичних занять для бакалаврів спеціальності 141 Електроенергетика, електротехніка та електромеханіка / А.А. Колб, Г.Г. Дяченко, О.В. Садовой; Нац. техн. ун–т. «Дніпровська політехніка». – Д.: НТУ «ДП», 2021. – 83 с.

Additional

1. Попович М.Г., Лозинський О.Ю., Клепіков В.Б. та інш. Електромеханічні системи автоматичного керування та електроприводи. Навч. посіб. за напрямом «Електромеханіка» / М.Г. Попович, О.Ю. Лозинський, В.Б. Клепіков та інш. – К.: Либідь, 2005. Ч1.– 397 с.; Ч2. – 680 с.

2. Попович М.Г., Ковальчук О.В. Теорія автоматичного керування: Підручник. – К.: Либідь, 1997. – 544 с.

3. Піцан Р., Барадачевский В., Бойчук Б. Збірник задач до курсу «Електропривод». – Львів, Видавництво «Львівська політехніка», 1999. – 426 с

Information resources

Література на сайті кафедри електропривода:
https://elprivod.nmu.org.ua/ua/books/automaticED.php