



## Syllabus Course Program

# Basic of Electric Drive

### Specialty

171 – Electronics

### Institute

Institute of Education and Science in Power Engineering, Electronics and Electromechanics

### Educational program

Electronics and telecommunications

### Department

Department of Automated Electromechanics Systems

### Level of education

Bachelor's level

### Course type

Free choice

### Semester

6

### Language of instruction

English

## Lecturers and course developers



### Tetiana Kunchenko

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Candidate of technical sciences, associate professor, associate professor of the department of automated electromechanical systems of NTU “KhPI”

Work experience - 27 years. Author of more than 50 scientific and educational and methodological works. Leading lecturer in the disciplines: “Electric drive”, “Fundamentals of electric drive”.

[More about the lecturer on the department's website](#)

## General information

### Summary

The subject of the training course of the discipline highlights the principles of construction, design, automation and operation of electric drives and their control methods.

### Course objectives and goals

To form students' concepts and provide knowledge on the basics of electromechanical systems. Study of electromechanical systems of an electric drive.

### Format of classes

Lectures, practical classes, self-study and consultations. Final control – differentiated standings

### Competencies

- PK-1 the ability to use computerized systems of automated design and engineering calculations, appropriate packages of application programs in the development of engineering and design projects of electronic and multimedia information devices and systems;
- PK-2 the ability to demonstrate and use knowledge and understanding of scientific concepts, theories and technologies, methods of calculation, analysis and synthesis necessary for the design and application of electronic and acoustic systems, multimedia devices;

- *PK-3 the ability to use modern information technologies and computer software, skills in working with computer networks, databases and Internet resources to solve engineering problems in the field of electronics, acoustics and multimedia systems;*
- *PK-4 the ability to use basic knowledge of physics, higher mathematics, theoretical foundations of electrical engineering and electrical engineering materials to solve practical problems in the field of electronics and telecommunications;*
- *PK-5 the ability to demonstrate and use knowledge of the characteristics and parameters of electronic equipment materials, analog and digital electronic devices, microprocessor systems;*
- *PK-6 the ability to use modern methods of calculations, modeling and analysis of electronic equipment operating modes and designing and modeling of electronic and multimedia information systems;*
- *PKs1-4 the ability to apply methods and technologies of analysis, synthesis, modeling, calculation and optimization of electronic and multimedia devices;*
- *PKs2-4 ability to apply methods and technologies of analysis, synthesis, design, modeling, examination and optimization of multimedia information systems and their components.*

### **Learning outcomes**

- *RNp-6 to evaluate parameters of the technical condition of electronic devices, organize and carry out scheduled and unscheduled maintenance, adjustment of technological equipment in accordance with current production requirements;*
- *PHs1-2 to be able to perform calculations for the analysis of transient and steady modes of operation of industrial electronics devices;*
- *PHz-4 to demonstrate the skills of independent and collective work, leadership qualities, the ability to organize the work of teams of performers in the field of design, development, analysis, calculation, modeling, production and testing of electronic and multimedia devices and systems;*
- *Rnz-7 to combine knowledge and skills of mathematical modeling and optimization of electronic equipment for use in automation and telecommunications systems.*

### **Student workload**

*The total volume of the course is 90 hours (3 ECTS credits): lectures – 24 hours, practical classes – 12 hours, self-study – 54 hours.*

### **Course prerequisites**

*Higher mathematics, Physics, Theoretical foundations of electrical engineering, Electric machines and devices.*

### **Features of the course, teaching and learning methods, and technologies**

*The learning process in the discipline involves lectures, practical and laboratory work, one calculation task, two control tasks, independent work and consultations. Teaching theoretical material using a basic (reference) synopsis. Practical classes consist of solving problems, which allows you to consolidate the lecture material. Independent processing of the materials of the theoretical and practical parts of the discipline using literary sources; execution and protection of control work.*

## **Program of the course**

### **Topics of the lectures**

*Topic 1. Preface. General Information.*

*Functional diagram of an electric drive, classification of electric drives (EDP), modern trends in the development of ED.*

*Topic 2. Mechanical system of ED movement.*

*Equations of motion and operating modes of EP. Bringing moments of inertia, masses and displacements. Finding stiffness coefficients.*

*Topic 3. Reduction of stiffnesses of elastic connections, moments and resistance forces.*

*Generalized calculation schemes of the mechanical part of the EP. Taking into account losses when applying load moments and forces. Compilation of the calculation scheme of the mechanical part of the electric drive.*

#### **Topic 4. Schematic diagram of DPT with NZ.**

Natural mechanical characteristics. Artificial mechanical and electromechanical characteristics when the resistance of the armature circuit, applied voltage and excitation current change. Operating modes of Direct current motor with independent excitation (DCM IE): motor, anti-lock, regenerative, dynamic braking

#### **Topic 5. Equations and structural scheme.**

With an alternating flow of excitation, with a constant flow of excitation.

#### **Topic 6. Research of electromechanical and mechanical characteristics of DCM IE.**

#### **Topic 7. Electromechanical properties of Direct current motor with series excitation (DCM SE).**

Schematic diagram and equations. Structural diagram. Natural static characteristics. Artificial mechanical and electromechanical characteristics when changing the resistance of the armature circuit, applied voltage. DCM operation modes with software: anti-lock, dynamic braking with independent excitation and series excitation.

#### **Topic 8. Electromechanical properties of Direct current motor with mixed excitation.**

Schematic diagrams and equations. Mechanical and electromechanical characteristics.

#### **Topic 9. Research of electromechanical and mechanical characteristics of DCM SE.**

#### **Topic 10. Mathematical description of processes of electromechanical conversion of energy in asynchronous motor.**

Static characteristics. Natural mechanical characteristics. Modes of operation. Artificial mechanical characteristics when additional active and inductive resistances and applied voltage are changed. Artificial mechanical characteristics when changing the stator current frequency. Dynamic braking mode.

Electromechanical properties of AM. Characteristics of a synchronous motor.

#### **Topic 11. General information.**

The main indicators of regulated EP in static and dynamic modes.

#### **Topic 12.**

Generator-engine system. System thyristor converter-engine. Frequency converter system-asynchronous motor.

#### **Topic 13, 14.**

Structural diagrams of the G-D system. Ways to increase the speed of the G-D system.

#### **Topic 15, 16.**

Terms. Method of equivalent quantities. Classes of insulating materials. Modes of operation, heating and cooling of electric motors. Choice of engines.

### **Topics of the practical classes**

**Topic 1. Compilation of the calculation scheme of the mechanical part of the electric drive**

**Topic 2. Calculation and construction of natural and artificial characteristics of DCM IE**

**Topic 3. Calculation and construction of natural and artificial characteristics of DCM SE**

**Topic 4. Calculation and construction of natural and artificial characteristics of AM**

**Topic 5. Calculation of transient processes in an electric drive**

**Topic 6. Selection and calculation of the drive motor**

### **Topics of the laboratory classes**

Laboratory classes are not scheduled

### **Self-study**

The course involves the implementation of a calculation task on the topic: Development of the "Generator-motor" system. Based on the results of the calculations, a written report is drawn up. After checking the report, the student must defend the calculation task.

### **Course materials and recommended reading**

1. Теорія електропривода: Підручник / м. Г. Попович, м. Г. Борисюк, в. А. Гаврилук та ін.; За ред. М. Г. Поповича. – к.: Вища шк., 1993. – 494 с.

2. Зеленов А.Б. Теорія електропривода. Методика проектування електроприводів: підручник / А.Б. Зеленов. – Луганськ: вид-во «Ноулідж», 2010.– 670 с.

3. Електромеханічні системи автоматизації та електропривод (теорія і практика):  
Учебний посібник/ За ред. М.Г.Поповича, В.В.Кострицького. - К.: КНУТД, 2008. - 408 с.
4. Кутовий Ю.М., Кунченко Т.Ю., Обруч І.В. Теорія електроприводу в задачах та прикладах.  
Навчально-методичний посібник. - Х.: ХНАДУ, 2016. - 92с.
5. Електропривод: навчально-методичний посібник / Ю.М. Кутовий, Т.Ю. Кунченко, Д.О. Пшенични-  
ков, І.В. Обруч.– Харків: НТУ «ХПІ», 2020. – 125 с.

## Assessment and grading

### Criteria for assessment of student performance, and the final score structure

Description of the final score structure, course requirements, and necessary steps to earn points, especially paying attention to self-study and individual assignments.

### Grading scale

<i>Total points</i>	<i>National</i>	<i>ECTS</i>
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

## Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.

Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: <http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/>

## Approval

Approved by

Date, signature

*Head of the department*  
Bohdan VOROBYOV

Date, signature

*Guarantor of the educational program*  
Viacheslav KULICHENKO