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

Department of
Electromechanics FEA

Powerful electromechanical complexes and energy savings during their operation

Working program of the academic discipline (Syllabus)

Details of the academic discipline	
Level of higher education	***Second (master's)***
Branch of knowledge	*14 "Electrical engineering"*
Specialty	*141 "Electric power engineering, electrical engineering and electromechanics"*
Educational program	***Electric machines and devices*** *(Electrical machines and apparatus)*
Discipline status	*Selective*
Form of education	*Daytime*
Year of training, semester	*1st year, 2nd semester*
Scope of the discipline	*180 hours / 6 ECTS credits*
Semester control/ control measures	*Exam/MCR*
Lessons schedule	*http://roz.kpi.ua/*
Language of teaching	*Ukrainian*
Information about the course leader / teachers	Lecturer:*Ph.D. Mykhailo Anatoliyovych Kovalenko, 0676563651* Ph.D. Assoc. Mykola Oleksandrovych Reutsky 0501724189 Practical:*Ph.D. Mykhailo Anatoliyovych Kovalenko, 0676563651* Ph.D. Assoc. Mykola Oleksandrovych Reutsky 0501724189
Placement of the course	https://do.ipo.kpi.ua/course/view.php?id=741

Curriculum discipline

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

The program of the educational discipline "Powerful electromechanical complexes and energy saving during their operation" is compiled in accordance with the institution for the training of specialists in the field of knowledge14 "Electrical engineering" in the specialty 141 "Electrical power engineering, electrical engineering and electromechanics" in the specialization "Electrical machines and devices" educational - qualification levels master of science and master's degree professional.

The educational discipline belongs to the cycle of selective educational disciplines.

The purpose of the educational discipline *there is an orientation of students in modern applications of production complexes in relation to the most common electrical technologies, both mechanical and electrophysicochemical; determine the main functional roles of power, regulation, clearing and protection systems, as well as the electrical machines and devices used in them.*

The subject of the educational discipline is a system of properties and features of the use of electromechanical energy converters in modern production electromechanical complexes.

General competences:

ZK3.*Ability to apply knowledge in practical situations.*

Professional competences:

FC2.*The ability to develop and implement measures to increase reliability, efficiency and safety in the design and operation of equipment and objects of the power industry, electrical engineering and electromechanics.*

FC11.*The ability to evaluate indicators of reliability and efficiency of the functioning of electric power, electrotechnical and electromechanical objects and systems.*

Program learning outcomes:

PR02.*Outline a plan of measures to increase the reliability, safety of operation and prolong the resource of electric power, electrotechnical and electromechanical equipment and relevant complexes and systems.*

PR03.*Analyze processes in electric power, electrotechnical and electromechanical equipment and corresponding complexes and systems.*

PR16.*Outline a plan of measures to increase the reliability, safety of operation and prolong the resource of electric power, electrotechnical and electromechanical equipment and relevant complexes and systems.*

Knowledge:general systems that characterize the generalized technological process; systems of control and protection of complexes.

Skills:selection of the necessary electromechanical equipment; analyze possible ways to save energy; project quality assessment.

Experience:analysis of components of an electromechanical complex on a specific example.

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

To successfully master the discipline, the student must have: higher mathematics, physics, theoretical foundations of electrical engineering, electrical machines. The discipline "Powerful electromechanical complexes and energy saving during their operation", using the known laws of electrical engineering, creates a methodology for calculations and selection and analysis of production complexes, their modernization taking into account modern requirements for energy efficiency. The content of the credit module contains general requirements for modern electromechanical complexes, generalized types of technologies and their components, which should be related to the competence of a specialist engineer - electromechanics and a research engineer, a choice taking into account the requirements for the operation of sources of traditional modern technologies.

3. Content of the academic discipline

The discipline structurally consists of 5 sections, namely:

1. ***Introduction, generalized models of production electromechanical complexes****, which included questions about typical production technologies; Synthesis of typical functional systems in the multi-level structure of production electromechanical complexes; Generalized requirements for work of production electromechanical complexes.*
2. ***The main thing electromechanical power equipment for mechanical technologiestechnologies****, which included questions about the specifics of the use of production primary sources of electrical energy; Production electromechanical autonomous specialized sources of mechanical energy; Electric motorsformechanisms of periodic and continuous action; Production micromachine complexes; Electric motors for special technological purpose; Use of electric motors of modern designs.*
3. ***Basic electromechanical power equipment for electrophysical and chemical technologies****, which included questions about industrial electromechanical autonomous specialized sources of electrical energy; Electric energy-converting devices of thermal technologies; Electromechanical power converters for electric welding technologies; Energy converting devices for dimensional processing of materials; Energy converting devices for aerosol and electrochemical technologies.*
4. ***Electric devices control systems of production electromechanical complexes****, which included questions about generalized analysis methodsregulation of production electromechanical complexes; Generalized analysis of the manifestations of transient processes in the regulation of production static electromechanical complexes; A generalized analysis of the manifestations of transient processes in the regulation of production dynamicelectromechanical complexes;*

Electrical switching devices in power channels; Electric regulation devices in power channels; Electric regulation devices in mechanical energy channels.

5. ***Electrical devices of the system of managing the work of production electromechanical complexes**, which included questions about the generalized analysis of systems and methods of managing the work of production electromechanical complexes; Electric signal sensors in automatic control systems; Executive and protective devices in automatic control systems; A generalized analysis of the properties of AC and DC executive motors.*

4. Educational materials and resources

Main information resources:

1. Industrial electromechanical complexes: Tutorial. for students higher education close./ V.M. Krasnikov, M.G. Anpilogov, M.O. Reutsky; Zazag. ed. V.M. Krasnikov, - K.: Norita-plus, 2007, - 184 p.: ill.. - Bibliogr.: C. 180.
2. Krasnikov V.M., Shinkarenko V.F. Industrial electromechanical complexes, K., Electronic version, 2003.
3. *Distance course "Powerful electromechanical complexes and energy saving during their operation"*

https://do.ipo.kpi.ua/course/view.php?id=741

Additional:

1. *Production electromechanical complexes: workshop [Electronic resource]: training. manual for students specialty 141 "Electric power engineering, electrical engineering and electromechanics", educational program "Electric machines and devices" / KPI named after Igor Sikorskyi; edited by: V. V. Chumak, M. A. Kovalenko, S. S. Tsyvinskyi. – Electronic text data (1 file: 76.83 KB). – Kyiv: KPI named after Igor Sikorskyi, 2022. – 55 p. The fretboard was provided by the Methodical Council of the KPI named after Igor Sikorskyi (protocol No. 6 dated 06/24/2022) — at the request of the FEA Scientific Council (protocol No. 10 dated 06/20/2022) https://ela.kpi.ua/handle/123456789/48888*
2. *Methodical instructions for practical classes in the discipline "Powerful electromechanical complexes and energy saving during their operation - 2. Production complexes" / Chumak V.V., Kovalenko M.A. // Kyiv: KPI named after Igor Sikorskyi, 2017. – 53 p.*
3. *Powerful electromechanical complexes and energy savings during their operation: Methodological instructions for practical classes for students of specialty 141 - "Electrical power engineering, electrical engineering and electromechanics", specialization "Electrical machines and devices" full-time study. incl. M. O. Reutskyi. - K.; NTUU "KPI", 2013 -... p. Ukraine language*
4. *Krasnikov V.M., Novikov A.V. Electromechanics. - K., Higher School, 1994. Krasnikov V.M. Electromechanics of industrial complexes - K., NCMVO, 1991. Informational and methodological publications.*

Educational content

5. Methods of mastering an educational discipline (educational component)

Lecture classes

No s/p	*The name of the topic of the lecture and a list of main questions (list of didactic tools, links to information sources)*
1	*Subject and tasks of the course. Typical technologies of production of a wide profile. Typical technologies of wide-profile industries and features of their modern development. Synthesis of typical functional systems in the multi-level structure of production electromechanical complexes.* *literary sources: [1, p. 15-31].*

	*distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 1*https://do.ipo.kpi.ua/course/view.php?id=741
2	*Requirements for the work of VEMK. Generalized requirements for the operation of production electromechanical complexes.* *literary sources [1, p. 32-40].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 2*https://do.ipo.kpi.ua/course/view.php?id=741
3	*Primary sources of electricity. Peculiarities of the use of industrial primary sources of electrical energy.* *literary sources [1.p. 41-50].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 3* https://do.ipo.kpi.ua/course/view.php?id=741
4	*Sources of mechanical energy. Industrial electromechanical autonomous specialized sources of mechanical energy.* *literary sources [1, c. 51-57].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 4* https://do.ipo.kpi.ua/course/view.php?id=741
5	*Electric motors. Electric motors for intermittent and continuous mechanisms.* *literary sources [1, pp. 58-68].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 5*https://do.ipo.kpi.ua/course/view.php?id=741
6	*Micromachine VEMK. Production micromachine complexes.* *literary sources [1, p.69-83].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 6*https://do.ipo.kpi.ua/course/view.php?id=741
7	*Special electric motors. Electric motors for special technological purposes.* *literary sources [1, p.84, 93].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 7*https://do.ipo.kpi.ua/course/view.php?id=741
8	*Modern electric motors. Use of electric motors of modern designs.* *literary sources [1, p.94-99].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 8*https://do.ipo.kpi.ua/course/view.php?id=741
9	*Industrial electromechanical autonomous specialized sources of electrical energy. Autonomous sources of electrical energy. Electrical energy converting devices for thermal technologies. EMO for thermal technologies.* *literary sources [1, c. 100...110, pp. 111..114].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 9*https://do.ipo.kpi.ua/course/view.php?id=741
10	*Electromechanical power converters for electric welding technologies. EMO for electric welding. Energy converting devices for dimensional processing of materials. Electrophysicochemical dimensional treatment of materials. Energy converting devices for electroaerosol and electrochemical technologies. Electroaerosol and electrochemical technologies.* *literary sources [1, c. 115...119, p. 120...124, pp. 125, 128].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 10* https://do.ipo.kpi.ua/course/view.php?id=741
11	*Generalized analysis of methods of regulation of industrial electromechanical complexes. VEMK regulation methods.* *literary sources [1, p. 129...141].*

	distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 11 https://do.ipo.kpi.ua/course/view.php?id=741
12	*Generalized analysis of the manifestations of transient processes during the regulation of industrial static electromechanical complexes. Regulation of static VEMK. Generalized analysis of the manifestations of transient processes during the regulation of production dynamic electromechanical complexes. Regulation of dynamic VEMK.* *literary sources [1, p. 142...170].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 12* https://do.ipo.kpi.ua/course/view.php?id=741
13	*Electric devices for regulation in electric energy channels. Lecture 13. Regulators in electric power circuits. Electric regulation devices in mechanical energy channels. Electromagnetic clutches.* *literary sources [1,. pp. 171 – 182].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 13* https://do.ipo.kpi.ua/course/view.php?id=741
14	*Generalized analysis of systems and methods of managing the work of production electromechanical complexes. Management methods of VEMK.* *literary sources [1, p. 183 – 199].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 14* https://do.ipo.kpi.ua/course/view.php?id=741
15	*Executive and protective devices in automatic control systems. Electric protection devices of VEMK.* *literary sources [1, c.200 - 208].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 15* https://do.ipo.kpi.ua/course/view.php?id=741
16	*A generalized analysis of the properties of AC and DC executive motors. Main properties of executive engines.* *literary sources [1, c. 209 – 222].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 16* https://do.ipo.kpi.ua/course/view.php?id=741
17	*Electric devices for remote transmission of information about the movement of the controlled object. Informational electrical devices.* *literary sources [1, c. 223 - 230].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 17* https://do.ipo.kpi.ua/course/view.php?id=741
18	*Electric signal sensors in automatic control systems. Electric sensors.* *literary sources [1, c. 215 - 219].* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 18* https://do.ipo.kpi.ua/course/view.php?id=741
19	***Energy systems of electromechanical complexes.****The search for potential resource opportunities for more economical use of electrical energy in the operation of electrical machines and transformers. Schemes of unregulated industrial electromechanical and electrophysicochemical complexes.* ***Ways of realizing energy saving by means of an industrial electric drive in an unregulated***

	electromechanical complex.*Improvement of engine selection, transition to energy-saving electrical equipment, evaluation of engine characteristics and their thermal state.* *Literary sources: [1] p. 15-17; [2] p. 13-15; with. 10-18; [4, 6];* *Tasks on SRS:elaboration of the material according to the synopsis and literature.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 19https://do.ipo.kpi.ua/course/view.php?id=741*
20	***Regulated systems of electromechanical complexes.****Schemes of the adjustable electromechanical complex. EMC control systems and control system.* ***Ways of realizing energy saving by means of an industrial electric drive in an adjustable electromechanical complex.****Elimination of intermediate gears. Application of group, single or multi-motor drive. Increasing the efficiency of technological processes. Selection of rational operating modes of electrical equipment. Improving the quality of electricity.* *Literary sources:[1] p. 99-115; with. 118-131; [2] p. 46-80;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. The search for an electromechanical complex to perform an individual task.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 20https://do.ipo.kpi.ua/course/view.php?id=741*
21	***Selection of regulation and protection equipment.****Classification of electrical devices. Starting, switching and protective. Selection of electrical appliances according to purpose for specific operating conditions.* ***Selection of the main energy-saving objects.****The main sources of active power loss. Typical structures of industrial production. General model of energy consumption in production.* *Literary sources:[1] p. 18-24; [9] p. 7-31; [4] p. 99-137;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Selection of regulation and protection equipment for EMC of an individual task.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 21https://do.ipo.kpi.ua/course/view.php?id=741*
22	***Conditions for creating energy-saving models.****Search for possibilities and methods of maximum reduction of electricity losses. Structures of energy channels and losses in them. Schemes of replacement of energy objects. Load schedules.* *Literary sources:[1] p. 18-24; with. 41-47; [2] p. 13-21; [7] p. 111-117;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. The search for ways to reduce the energy intensity of EMC from an individual task.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 22https://do.ipo.kpi.ua/course/view.php?id=741*
23	***Regulation of the load of transformers.****Load factor and efficiency factor of transformers. Regulation of purely active load. Scheme of replacing the transformer with a purely active load.* *Literary sources:[1] p. 47-50; [2] p. 135-137; [7] p. 117-121;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Conditions of maximum efficiency. Dependence of efficiency on the type of load.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 23https://do.ipo.kpi.ua/course/view.php?id=741*
24	***Losses of active power and efficiency of transformers.****Unregulated and regulated mode of operation of transformers. Permanent and variable losses. Conditions of maximum efficiency of transformers and ways of reducing and redistributing losses.* *Literary sources:[1] p. 18-24; with. 41-47; [2] p. 13-21; [7] p. 111-117;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Choosing an EMC power source for an individual task.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 24https://do.ipo.kpi.ua/course/view.php?id=741*
25	***The influence of reactive currents on the properties of the transformer.****The influence of reactive*

	currents on the efficiency of transformers. Active power losses in transformer windings in the presence of reactive currents. Conditions for maximum efficiency in the presence of reactive currents. *Literary sources:[1] p. 41-47; [7] p. 115-117;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Ways to reduce the consumption of reactive currents.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 25https://do.ipo.kpi.ua/course/view.php?id=741*
26	***Effectiveness of reactive power compensation in transformers.****Dependencies of power losses in transformers on the level and nature of the load. Calculation of losses in the presence and absence of means of reactive power compensation. Longitudinal and transverse compensation.* *Literary sources:[1] p. 24-27; [7] p. 121-122;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Finding ways to compensate reactive currents.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 26https://do.ipo.kpi.ua/course/view.php?id=741*
27	***Regulation of the primary voltage of transformers.****Analysis of transformer properties during voltage regulation and purely active load. Power losses in steel and windings. Conditions for minimum power losses in the transformer during voltage regulation. The law of voltage regulation depending on the load factor and transformer parameters.* *Literary sources:[1] p. 18-24; with. 41-47; [2] p. 13-21; [7] p. 111-117;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Ways of regulating the voltage of energy objects under load.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 27https://do.ipo.kpi.ua/course/view.php?id=741*
28	***Evaluation of the effectiveness of regulation of production transformers.****Transformers with one-factor, two-factor and three-factor regulation with compensation of reactive power consumption. Implementation of group methods of operation of transformers.* *Literary sources:[1] p. 27-31; [7] p. 122-123;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Optimization of load modes and switching on parallel operation of transformers.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 28https://do.ipo.kpi.ua/course/view.php?id=741*
29	***Features of operation of asynchronous motors.****The choice of asynchronous motors and their influence on the reliability of the technological process depending on the mode of operation. Ways to reduce losses in AD and their economic feasibility. Transient processes during AD operation and their influence on energy indicators.* ***Calculation of power and selection of electric motors.****The main requirements when choosing an electric motor. Checking the engine for start-up and overheating conditions. Taking into account the type and mode of loading.* *Literary sources:[1] p. 18-24; with. 41-47; [2] p. 13-21; [7] p. 111-117;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Calculation of the necessary power of the EMC electric motor from an individual task.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 29https://do.ipo.kpi.ua/course/view.php?id=741*
30	***Conditions for creating analytical models of asynchronous motors.****A simplified scheme for replacing AD. Losses in the stator and rotor windings.* *Literary sources:[1] p. 34-37;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Calculation of losses in an EMC electric motor for the nominal mode of operation distance course "Powerful*

	electromechanical complexes and energy saving during their operation" lecture 30https://do.ipo.kpi.ua/course/view.php?id=741
31	***Minimization of active power losses in asynchronous motors.****Preliminary analysis of losses in an induction motor without taking into account the magnetizing current. Conditions of maximum efficiency. Ways to reduce losses by adjusting the supply voltage. Minimum loss conditions. Potential energy savings.* *Literary sources:[1] p. 37-39;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Calculation of the minimum losses in the EMC electric motor under the condition of adjusting the supply voltage.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 31https://do.ipo.kpi.ua/course/view.php?id=741*
32	***Taking into account the influence of reactive currents on the energy-saving properties of asynchronous motors.****Active and reactive components of the motor current. Losses in AD taking into account the reactive current of the stator winding when adjusting the supply voltage. Conditions for maximum efficiency and minimum losses. A potential resource of savings.* *Literary sources:[7] p. 168-176;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Calculation of the EMC saving resource under the condition of minimizing losses.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 32https://do.ipo.kpi.ua/course/view.php?id=741*
33, 34	***Change in reactive power consumption when adjusting the supply voltage.****Dependencies of the consumed reactive power on the load in voltage-regulated and non-voltage-regulated forms of operation of an asynchronous motor. Optimization of the voltage regulation law according to the criterion of minimum losses, taking into account the reactive current.* ***Efficiency of energy-saving voltage regulation in an asynchronous motor.****Methods of determining the distribution of power losses in an asynchronous motor. Total losses in AD when changing the load and when adjusting the supply voltage. Optimization of blood pressure regulation taking into account all operational factors. An example of energy-saving regulation of an asynchronous motor.* *Literary sources:[7] p. 168-176;* *Tasks on SRS:elaboration of the material according to the synopsis and literature. Optimization of EMC electric motor regulation taking into account all operational factors.* *distance course "Powerful electromechanical complexes and energy saving during their operation" lecture 33, 34https://do.ipo.kpi.ua/course/view.php?id=741*

Practical training

No s/p	*Name of the subject of the lesson and list of main questions*
1	*Generalized models of industrial electromechanical complexes.* *literary sources [1], pp. 144-153;* *distance course "Powerful electromechanical complexes and energy saving during their operation"* https://do.ipo.kpi.ua/course/view.php?id=741
2	*Consolidation of the main provisions of modeling.* *literary sources [1], pp. 11-22; [2], pp. 11-15;* *distance course "Powerful electromechanical complexes and energy saving during their operation"* https://do.ipo.kpi.ua/course/view.php?id=741
3	*Basic electromechanical equipment for mechanical technologies. Modular control work (part 1).* *literary sources [1], p. 181-182;* *distance course "Powerful electromechanical complexes and energy saving during their operation"* https://do.ipo.kpi.ua/course/view.php?id=741
4	*EMO for mechanical technologies. Electrothermal technologies.* *literary sources [4], p. 191-192;* *distance course "Powerful electromechanical complexes and energy saving during their operation"* https://do.ipo.kpi.ua/course/view.php?id=741
5	*Electric motors. Electric welding technologies. Electrical devices of regulation systems of production electromechanical complexes.* *literary sources [3], p. 211-212.* *distance course "Powerful electromechanical complexes and energy saving during their operation"* https://do.ipo.kpi.ua/course/view.php?id=741
6	*Basic electromechanical power equipment for electrophysicochemical technologies. Electrothermal technologies.* *literary sources [3], p. 223-234;* *distance course "Powerful electromechanical complexes and energy saving during their operation"* https://do.ipo.kpi.ua/course/view.php?id=741
7	*Electric adjustment devices. Solving problems.* *literary sources [3], pp. 242-245.* *distance course "Powerful electromechanical complexes and energy saving during their operation"* https://do.ipo.kpi.ua/course/view.php?id=741
8	*Electrical devices of control systems. Modular control work (part 2).* *literary sources: [3], pp. 246-250.* *distance course "Powerful electromechanical complexes and energy saving during their operation"* *individual tasks for MKR part II* https://do.ipo.kpi.ua/course/view.php?id=741
9	***Energy-saving control models and load diagrams of electromechanical complexes.*** *Literary sources [1, 2];* *Tasks on SRS:Selection of standard EMC load modes for an individual task and creation of a load diagram.* *distance course "Powerful electromechanical complexes and energy saving during their operation" selection of tasks by topic 1,2https://do.ipo.kpi.ua/course/view.php?id=741task*

10, 11	***Calculations of the efficiency of transformer load regulation. Calculations of the effectiveness of voltage regulation of the transformer network.*** *Literary sources [1, 2];* *Tasks on SRS:Conditions of maximum efficiency. Dependence of efficiency on the type of load. Methods of adjusting the EMC voltage of an individual task under load.* *distance course "Powerful electromechanical complexes and energy saving during their operation" selection of tasks by topic 1,2https://do.ipo.kpi.ua/course/view.php?id=741task*
12, 13	***Study of the short-circuit mode of an asynchronous motor.*** *Didactic support– educational stand for AD tests;* *Literary sources [1, 2]; GOST 183-74; testing methodology;* *Tasks on the SRS: Program of acceptance and passing tests of AD. GOST 11828-81.* *distance course "Powerful electromechanical complexes and energy saving during their operation" selection of tasks by topic 3,4https://do.ipo.kpi.ua/course/view.php?id=741task*
14, 15	***Study of the idle mode of an asynchronous motor.*** *Didactic support– educational stand for AD tests;* *Literary sources [1, 2]; GOST 183-74; testing methodology;* *Tasks on the SRS: Program of acceptance and passing tests of AD. GOST 11828-81.* *distance course "Powerful electromechanical complexes and energy saving during their operation" selection of tasks by topic 3,4https://do.ipo.kpi.ua/course/view.php?id=741task*
16	***Creation of analytical models of energy-efficient asynchronous motors. Calculations of the influence of reactive currents on the energy-saving properties of asynchronous motors.*** *Literary sources [1, 2];* *Task on SRS: Calculations of the influence of reactive currents on the energy-saving properties of electrical equipment from an individual task* *distance course "Powerful electromechanical complexes and energy saving during their operation" selection of tasks by topic 5,6https://do.ipo.kpi.ua/course/view.php?id=741task*
17	***Calculations of the effect of the quality of electricity on the energy-saving properties of electrical equipment. Generalization of organizational methods for resource conservation during operation of industrial electromechanical complexes.*** *Literary sources [1, 2];* *Tasks on SRS:Recommendations for energy saving during the operation of EMC of an individual task.* *distance course "Powerful electromechanical complexes and energy saving during their operation" selection of tasks by topic 5,6https://do.ipo.kpi.ua/course/view.php?id=741task*
18	***Listening and discussing students' reports based on the results of individual homework.*** *Didactic support– computer and projector;* *Literary sources– presentation of an individual task;* *Task on SRS: preparation of a report based on the materials of an individual task.* *distance course "Powerful electromechanical complexes and energy saving during their operation" selection of tasks by topic 7,8https://do.ipo.kpi.ua/course/view.php?id=741task*

6. Independent work of student

No. z/p	Type of independent work	Number hours of SRS
1	Preparation for classroom classes	8
2	Calculations based on primary data obtained in practical classes	27
3	Analysis of additional literature and performance of additional tasks	5
4	Study of software products for work in practical classes	4

5	Preparation for MKR	16
6	Preparation for the test	12

Policy and control

7. Policy of academic discipline (educational component)

The system of requirements that the teacher sets before the student:

- *rules for attending classes: in accordance with Order 1-273 dated 09/14/2020, it is prohibited to evaluate the presence or absence of the winner at the classroom class, including awarding incentive or penalty points. According to the RSO of this discipline, points are awarded for the corresponding types of educational activity in lectures and laboratory works.*
- *rules of behavior in classes: the student has the opportunity to receive points for the appropriate types of educational activity in lectures and practical classes, provided for by the RSO of the discipline. The use of means of communication to search for information on the teacher's Google Drive, on the Internet, in a distance course on the Sikorsky platform is carried out under the condition of the teacher's instructions;*
- *rules for assigning incentive and penalty points: incentive and penalty points are not included in the main scale of RSO, and their sum does not exceed 10% of the starting scale. Incentive points are awarded for participation in faculty and institute Olympiads in the discipline "*Powerful electromechanical complexes and energy savings during their operation*", participation in faculty and institute scientific conferences. Penalty points are awarded for late completion of laboratory work.*
- *policy of deadlines and rescheduling: late completion of practical tasks involves the calculation of penalty points. If the student did not pass or did not appear at the MKR, his result is evaluated at 0 points;*
- *policy regarding academic integrity: the Code of Honor of the National Technical University of Ukraine "Kyiv Polytechnic Institute" https://kpi.ua/files/honorcode.pdf establishes general moral principles, rules of ethical behavior of individuals and provides a policy of academic integrity for persons working and studying at the university, which they should be guided by in their activities, including when studying and preparing control measures in the discipline "Powerful electromechanical complexes and energy saving during their operation";*
- *when using digital means of communication with the teacher (mobile communication, e-mail, correspondence on forums and social networks, etc.), it is necessary to observe generally accepted ethical norms, in particular, to be polite and limit communication to the working hours of the teacher.*

8. Types of control and rating system for evaluating learning outcomes (RSO)

Current control*: express survey, MKR, problem solving*
Calendar control*: is conducted twice a semester as a monitoring of the current state of fulfillment of the syllabus requirements.*
Semester control*: exam*
Terms of admission to semester control*: minimum positive assessment for work in practical and lecture classes, module control, semester rating of more than 40 points.*
Table of correspondence of rating points to grades on the university scale:

Scores	*Rating*
100-95	*Perfectly*
94-85	*Very good*
84-75	*Fine*
74-65	*Satisfactorily*
64-60	*Enough*
Less than 60	*Unsatisfactorily*

Admission conditions not met	*Not allowed*

The student's overall rating after the end of the semester consists of points obtained for:

- *answers during express surveys at lectures;*
- *execution and protection of four laboratory works;*
- *performance of two control works within the framework of the modular control work (MCK).*

Express survey	*Practical work*	*MKR*	*Rs*	*Rec*	*R*
6	*24*	*30*	*60*	*40*	*100*

Answers during express surveys at lectures

*The weighted point is 3. The maximum number of points in all lecture classes is equal to: 3 points*2 = 6 points.*

Evaluation criteria:

- *3 points — a fully reasoned answer,*
- *1...2 points — an insufficiently substantiated answer,*
- *0 points - no or wrong answer*

Practical work

*The weighted point is 6. The maximum number of points for all practical works is equal to: 6 points*4 = 24 points.*

Evaluation criteria:

- *1 points — preparation for practical work,*
- *2 points — performance of practical work,*
- *3 points — job protection.*

Modular control work

*The weighted point is 15. The maximum number of points for all test papers is equal to: 15 points*2 = 30 points. Evaluation criteria:*

- *15 points - a complete reasoned answer,*
- *8 ... 10 points - insufficiently substantiated answer,*
- *6...7 points - presence of 1-2 errors,*
- *3 points - unsubstantiated answer with errors.*

Calendar control is based on the current rating. A condition for a positive assessment is the value of the student's current rating of at least 50% of the maximum possible at the time of assessment.

The form of semester control is an exam

The credit work consists of theoretical questions performed in the form of tests.

Evaluation criteria of the exam

The maximum rating of the exam Re = 40 points.

Exam rating Re = 33 – 40 points – the student gave comprehensive answers to all questions (and additional ones if necessary), gives clear definitions of all concepts and values, answers are logical and consistent.

Exam rating Re = 25 – 32 points – when answering questions, the student makes some mistakes, but can correct them with the help of the teacher; knows the definition of the main concepts and values of the discipline, generally understands the physical essence of electromagnetic processes in the objects studied.

Exam rating Re = 16 – 24 points – the student partially answers the exam questions, shows knowledge, but does not sufficiently understand the physical essence of electromagnetic processes of energy conversion. The answers are inconsistent and unclear.

Exam rating Re≤15 points - the student makes significant mistakes in the answer, shows a lack of understanding of the physical essence of electromagnetic processes, cannot correct mistakes with the help of the teacher. The answers are incorrect, and in some cases do not correspond to the essence of the question.

9. Additional information on the discipline (educational component)

List of topics that are submitted for semester control

1. Purpose and tasks of the discipline.
2. Structural typical three-level model of PEMK.
3. Types of specialized electric motors.
4. Synchronous jet micromotors. Design, principle of action.
5. Ways to adjust the welding current.
6. Features of voltage regulation of the transformer without disconnection from the network (on-load tap-changer).
7. Two types of regulation and equipment that is pleasant for them.
8. Schemes and principle of operation of the electromagnetic suspension.
9. Schematic diagram of remote control.
10. Executive asynchronous motor. Types of structures. Traverse.
11. Definition of production of a wide profile.
12. Structural model of two-level regulation of PEMK.
13. Peculiarities of transformer operation when powered by sinusoidal current.
14. Ways to eliminate the possibility of an explosion in explosive premises of PEMK.
15. Advantages of welding.
16. Scheme of the induction regulator.
17. Generalized expression for regulating the secondary EMF of the transformer.
18. Electromagnetic clutch with magnetic connection. Scheme, principle of action.
19. Schematic diagram of automatic control.
20. Structural diagram of a magnetoelectric relay and resistor sensors.
21. Types of PEMK technologies.
22. General requirements for the work of PEMK.
23. Necessary estimates are applied to electric motors in the design process.
24. Design features and operating properties of a hysteresis motor.
25. Processing of parts without removal of allowances in electrophysicochemical technology.
26. Diagram of a parametric voltage stabilizer.
27. Stages of the transitional process.
28. Types of electromechanical systems of contactors.
29. Types of automatic control.
30. Schemes of condensate parametric details.
31. A generalized model of connections of the technological system of PEMK.
32. What systems are distinguished in PEMK.
33. Three types of asynchronous motors of the 4A and AN series.
34. Flat Magnetodynamic pump. Design, principle of action.
35. The latest electrophysicochemical technology.
36. Diagram of a three-phase-two-phase transformer.
37. Substitution diagrams of an ideal asynchronous motor. Stability.
38. Electromechanical clutch with mechanical connection.
39. Generalized structural diagram of automatic control.
40. Hall sensor scheme. The principle of action.
41. Peculiarities of the development of mechanical technologies.
42. The simplest model of PEMK for mechanical technologies.
43. Influence of asymmetric load of transformers.
44. Magneto scheme.
45. What technologies are related to electrophysicochemical.
46. Scheme of a three-phase - six-phase transformer.
47. Features of starting DC and asynchronous motors.
48. Uniaxial effect when starting synchronous motors.

49. Scheme of an induction electromechanical sensor.
50. Types of transformer protection.
51. Generalized requirements for PEMK.
52. Three-level model of PEMK.
53. Features of operation when sinusoidal voltage is applied to the transformer.
54. DC motors used for mechanical technologies at PEMK.
55. Types of electrothermal sources by signs of use.
56. Three options for using an arc during electric welding. Volt-ampere characteristics of the arc.
57. Types of resistors in electric power regulation circuits.
58. Reed switch, design, principle of action.
59. Types of electric motor protection.
60. Diagram of a differential transformer sensor.
61. Types of PEMK technologies.
62. Two-level model of PEMK for mechanical technologies.
63. Power sources for mechanical technologies, their features.
64. Features of synchronous micromotors with permanent magnets. Design, launch.
65. List the types of electrophysicochemical technologies.
66. Scheme of an electrostatic generator, principle of operation.
67. Scheme of substitution of an ideal DC motor.
68. Determination of stability of synchronous motors. Fluctuation.
69. Types of relays are produced for automatic control, protection and control.
70. Scheme of inductive sensors and magnetostrictive sensor.

Certificates of completion of distance or online courses on the relevant subject can be credited provided that the requirements specified in Order No. 7-177 dated 10.01.2020 on approval of the regulation on recognition in KPI named after Ihor Sikorsky of learning outcomes acquired in non-formal/informal education

Working program of the academic discipline (syllabus):

Foldedassociate professor of the Department of Electromechanics FEA, Ph.D. Kovalenko M.A.

Approvedby the Department of Electromechanics FEA (protocol No. 10 dated 05/19/2023)
Agreed Methodical commission of the faculty[1](protocol No. 10 dated June 22, 2022)

The bibliography has been updated

The subject of practical classes has been updated