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«IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE»
FACULTY OF ELECTRIC POWER ENGINEERING AND AUTOMATICS
INSTITUTE OF ENERGY SAVING AND ENERGY MANAGEMENT

APPROVED
Vice Rector of Education

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«___»_____ 20___ .

F-CATALOG

of elective educational components of the educational and scientific program "Electric Power Engineering, Electrical Engineering and Electromechanics" of specialty 141 "Electric Power Engineering, Electrical Engineering and Electromechanics" of the third (educational and scientific) degree of the higher education

Approved:
by the Methodical council of the Igor Sikorsky KPI
(meeting protocol #____ of «___»_____20___)

by the Scientific council of Faculty of Electric Power Engineering and Automatics of the Igor Sikorsky KPI
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A Guide to the Catalog

1. The number and volume (in ECTS credits) of academic disciplines that can be chosen by the graduate student (elective disciplines) is determined by the curriculum, namely for the second year - 10 credits. The curriculum also indicates the semester, which teaches the elective discipline, the form of semester control, types and scope of classes.

2. Direct choice of disciplines by graduate students is carried out by means of questionnaires. Each graduate student fills out a questionnaire indicating the disciplines he / she wishes to study in the next academic year (taking into account the number of disciplines specified in the curriculum, their volume in ECTS credits and the semester of study).

3. The graduate student within a certain number can choose disciplines both from the faculty F-catalog and from the departmental F-catalog of any department of the faculty, regardless of the level of higher education (bachelor's, master's, educational-scientific), where he studies. The choice of academic disciplines offered for other educational programs is made in agreement with the head of the relevant graduating department.

4. In case of impossibility of formation of study groups of normative number for studying of a certain selective discipline, postgraduate students are given an opportunity to make a new choice during April, having joined already formed study groups. The department, which provides teaching of such elective discipline, can provide an opportunity to study the chosen discipline through individual consultations, using a mixed form of education and so on.

5. At the request of a graduate student who has chosen a certain elective discipline, he / she is allowed to join the group in which this discipline is taught within another educational program, including another faculty / institute. The relevant decision on the disciplines taught at the faculty is made by the dean of the faculty / director of the institute. With regard to disciplines taught at another faculty (institute), the relevant decision is made by the dean of the faculty with the consent of the dean of the faculty (director of the institute), whose department provides teaching of this discipline. In this case, the graduate student who has chosen such a discipline must agree in writing with possible minor changes in the scope of the discipline, the form and scope of training, the form of semester control.

6. A graduate student may not choose the same subject twice.

7. If a graduate student for a good reason could not choose the discipline in time, or found an error in his expression of will, he applies to the dean's office with an application for enrollment in the study of his chosen disciplines, providing the relevant documents. A graduate student who has neglected his right to choose will be enrolled to study those disciplines that the head of the graduating department will consider necessary to optimize study groups and flows.

8. The disciplines chosen by the graduate student are indicated in his individual curriculum.

9. More information on the procedure for the implementation by graduate students of the right to free choice of academic disciplines can be found in the Regulations on the exercise of the right to free choice of academic disciplines by applicants for higher education KPI. Igor Sikorsky (https://kpi.ua/free-choice-of-academic-disciplines-right).

Discipline 1 for study in the second year

Discipline	Analysis and synthesis of DC energy transmission systems
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Electrical networks and systems
Requirements for the beginning of the study	The study of the discipline is based on knowledge of the following disciplines: "Methods of research, formation and management of intelligent energy systems and complexes", "Fundamentals of the theory of electromagnetic fields and processes", "Unconventional and renewable energy sources in power systems and electrical complexes", "Monitoring, control and protection of electric power systems and electrotechnical complexes "," Foreign language for scientific activity "
What will be studied	General characteristics of high-voltage HVDC networks. Integration of DC systems into power systems. Mathematical models of HVDC. Protection of direct current networks.
Why it is interesting / necessary to study	The study of the discipline will professionally solve the following tasks: to analyze the mode parameters of AC systems with lines and inserts of DC, to create simulation models of electrical networks with lines and inserts of DC, to apply tools for research of DC lines and methods of analysis of hybrid networks.
Why you can learn (learning outcomes)	Perform analysis of operating modes of AC networks with inserts and DC lines; synthesis of calculation schemes for the study of DC transmission systems; develop simulation mathematical models in MatLab and Power Factory software environments
How to use the acquired knowledge and skills (competencies)	Plan and perform simulation studies of AC systems with lines and inserts of DC and tangential interdisciplinary areas using modern tools, understand the general principles and methods of technical sciences, as well as the methodology of experimental research, apply them in their own research in electrical engineering and teaching practice.
Information support	Discipline syllabus, https://classroom.google.com/c/MTUxNDQ0MzY5MTg5?cjc=m2shqxv
Type of classes	Lectures
Type of semester control	Test

Discipline	Methods of structural and parametric synthesis of regulators for systems with transport delay
Higher education degree	Third (educational and scientific)
Year	2nd year
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Power system automation
Requirements for the beginning of the study	The course is based on the knowledge gained by students in the study of the courses "Theory of automatic control", "Fundamentals and means of information transmission in electricity" and "Automatic and automated control in power systems".
What will be studied	Scientific principles on methods, organizational and technological measures of scientific research in the field of synthesis of regulators for systems with transport delay
Why it is interesting / necessary to study	Formation of a system of abilities to set and solve complex scientific problems during research and innovation activities in the field of automation of electric power systems,
Why you can learn (learning outcomes)	A characteristic feature of which, like most technological objects is the presence of significant delays in the control and measurement channels, due to the final speed of propagation of information signals in objects (transport delay), deepening knowledge of automatic control theory to solve problems of regulators systems with transport delay.
How to use the acquired knowledge and skills (competencies)	Effectively apply methods of synthesis of speed-optimal regulators for objects with delay; determine the classification of objects with a delay and their dynamic characteristics; Apply the acquired knowledge of research methods in the development of scientific papers; use special methods when performing research; organize and conduct research in the process of preparing a dissertation; to carry out approbation and implementation of research results in practice; have the skills to find independent solutions to scientific problems; choose topics for scientific work.
Information support	1. Syllabus. 2. Louis C. Westphal. Handbook of Control Systems Engineering. - 2nd edition; The Springer International Series in Engineering and Computer Science. - Springer, 2001. - T. 635. - 1063 s. 3. Automatic control systems / Farid Golnaraghi, Bendjamin C. Kuo. - John Wiley & Sons, inc. - 2009. - 786 p. 4. Introduction to digital control systems theory / A. Kulik, I. Dybska. - The textbook. - Kharkiv: National Aerospace University “Kharkov Aviation Institute”, 2007. - 165 p 5. Classical methods of automatic control. / Ed. A.A. Lanne. - СПб: БХВ - Петербург, 2004. - 640 с. 6. Popovich MI, Kovalchuk OV Theory of automatic control: Textbook. - K .: Lybid, 1997.-544p. 7. Automatic control systems with delay: textbook. allowance / Yu.Yu. Громов, H.A. Zemskoy, A.V. Lagutin, OG Иванова, B.M. Tobacconist. - Tambov: Tamb Publishing House. state tech. University, 2007. - 76 p 8. Dralyuk BN, Sinaisky GV Systems of automatic regulation of objects with transport delay: Library on automation, issue 341. - M .: "Energy", 1969. - 72 p. 9. AM Lityuga. Theoretical bases of construction of effective automatic

	control systems of TP / AM Lityuga, NV Klinachev, VM Mazurov.- 2002.- 216p
Type of classes	Classes are held in the form of lectures using demonstration material. Lectures are informative and problematic.
Type of semester control	Test

Discipline	Current trends in the integration of renewable energy sources into the power grid
Higher education degree	Third (educational and scientific)
Year	2nd year
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Renewable energy sources
Requirements for the beginning of the study	The course is based on the knowledge gained by students in the study of electrical networks and systems, photovoltaics, mathematical problems in renewable energy.
What will be studied	Scientific principles on methods, information and monitoring technologies used in RES power grids. These issues in this course are considered comprehensively, taking into account modern requirements for knowledge of technical, technological and economic aspects of renewable energy.
Why it is interesting / necessary to study	Formation of abilities to set and solve complex scientific problems during research and innovation activities in the field of renewable energy.
Why you can learn (learning outcomes)	Apply the necessary methods when performing research; find, process and store information in the study of scientific literature; to carry out approbation and implementation of research results in practice; have the skills to independently solve scientific problems, design research, preparation and defense of scientific work.
How to use the acquired knowledge and skills (competencies)	Ability to set and solve research problems in the field of joint work of renewable and traditional energy sources; ability to present and discuss the results of scientific research orally and in writing; ability to solve scientific problems related to the integration of RES in the power grid, reliability and efficiency of photovoltaic, wind power and hybrid systems; ability to adhere to research ethics as well as rules of academic integrity.
Information support	1.Sylabus. 2. Kothari D. P., Nagrath I. J. Modern Power System Analysis / New Delhi: Tata McGraw-Hill, 2003. - 694 p. 3. Padiyar K. R. FACTS controllers in power transmission and distribution / New Delhi: New Age International (P) Ltd., Publishers, 2007. - 532 p. 4. B.S. Stogniy, OV Кириленко, A.B. Prakhovnik, SP Denisyuk. Evolution of intelligent electrical networks and their prospects in Ukraine // Technical Electrodynamics, 2012, №5, p. 52 - 67. 5. Prospects for the use of synchronized vector measurements // http://digitalsubstation.com/blog/2018/05/07/perspektivy-primeneniya-sinhronizirovannyh-vektornyh-izmerenij/ 6.M.A. Mohamed, A.M. Eltamaly. Modeling and Simulation of Smart Grid Integrated with Hybrid Renewable Energy Systems / Springer, 2018. - 75 p. 7.Q.-C. Zhong and T. Hornik, Control of Power Inverters in Renewable Energy and Smart Grid Integration. Wiley-IEEE Press, 2013.- 438 p. 8.F. HM Rafi, MJ Hossain, J. Lu, Hierarchical controls selection based on PV penetrations for voltage rise mitigation in a LV distribution network // International Journal of Electrical Power and Energy Systems 2016. - 19 pp., Https://doi.org /10.1016/j.ijepes.2016.02.013 9.M. Hojabri et al. A Comprehensive Survey on Phasor Measurement Unit Applications in Distribution Systems // November 2019Energies, 2019. - 12 (23), DOI: 10.3390 / en12234552 10.G. B. Giannakis, V. Kekatos, N. Gatsis, S. Kim, H. Zhu and B. F. Wollenberg.

	Monitoring and Optimization for Power Grids: A Signal Processing Perspective // IEEE Signal Processing Magazine, vol. 30, no. 5, pp. 107-128, Sept. 2013, DOI: 10.1109 / MSP.2013.2245726. 11.S. Santoso, M.F. McGranaghan, R.C. Dugan, H.W. Beaty. Electrical Power Systems Quality, Third Edition // McGraw-Hill Education, 2012. - 522 p. Additional: 12. DSTU IEC 61000-4-30: 2010 (EN 61000-4-30: 2009) Electromagnetic compatibility (EMC). Part 4-30. Test and measurement methods. Measurement of electricity quality indicators. 13. E. Hossain et al. Analysis and Mitigation of Power Quality Issues in Distributed Generation Systems Using Custom Power Devices // IEEE Access, 2018. - DOI: 10.1109 / ACCESS.2018.2814981 14. J. Zhao et al., "Power System Dynamic State Estimation: Motivations, Definitions, Methodologies, and Future Work," in IEEE Transactions on Power Systems, vol. 34, no. 4, pp. 3188-3198, July 2019, DOI: 10.1109 / TPWRS.2019.2894769. 15. A. Sundararayan, T. Khan, A. Moghadasi, A.I. Sarwat. A Survey on Synchrophasor Data Quality and Cybersecurity Challenges, and Evaluation of their Interdependencies // J. Mod. Power Syst. Clean Energy, 2018. - DOI 10.1007 / s40565. 16. NKREKP, Resolution 13.12.2019 №2802. On amendments to the resolution of the National Commission for Regulation of Economic Competition of April 26, 2019 №641.
Type of classes	Classes are held in the form of lectures using demonstration material. Lectures are informative and problematic.
Type of semester control	Test

Discipline	Operating modes of wind power plants in power systems
Higher education degree	Third (educational and scientific)
Year	2nd year
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Renewable energy sources
Requirements for the beginning of the study	The course is based on the knowledge gained by students in the study of wind energy.
What will be studied	Scientific principles on methods, organizational and technological measures of scientific research in the field of wind energy
Why it is interesting / necessary to study	Formation of a system of abilities to set and solve complex scientific problems during research and innovation activities in the field of wind energy.
Why you can learn (learning outcomes)	Apply the necessary methods of scientific research in the development of scientific papers; use special methods when performing research; organize and conduct research in the process of preparing a dissertation; to carry out approbation and implementation of research results in practice; have the skills to find independent solutions to scientific problems; choose topics for scientific work.
How to use the acquired knowledge and skills (competencies)	Ability to perform original research, to achieve scientific results that create new knowledge in the field of wind energy; ability to present and discuss orally and in writing the results of scientific research in Ukrainian and English; ability to solve scientific problems of increasing the reliability and efficiency of wind power systems, due to the need to ensure sustainable development of the state; ability to identify, set and solve research tasks in the field of wind energy, evaluate and ensure the quality of research; ability to adhere to the ethics of research, as well as the rules of academic integrity in research and scientific and pedagogical activities.
Information support	1.Sylabus. 2. DSTU 3896: 2007 Wind power plants and wind power stations. Terms and definitions. –K .: Derzhspozhyvchstandart Ukrainy, 2008.-24p. 3. Шефтер Я.И. Use of wind energy.-M .: Energoatomizdat, 1983.-200p. 4. Sazonov VA, Belopolsky VA, Smirnov SB Some questions of design and extreme modes of operation of wind turbines with a horizontal axis of rotation: Textbook.-Sevastopol: SNIAEiP, 2004.-208p. 5.Fateev EM Wind turbines and wind turbines. –M .: Gosizdat s.h. lit., 1957. - 538c. 6. Krivtsov VS, Oleynikov AM, Yakovlev AI Inexhaustible energy. Book 1, 2. Wind generators.- Kharkov: Nat. Aerospace University "KHAI", Sevastopol: North National Technical University, 2003. -400p. 7. Wind energy. p / r D. de Renzo .– M .: Energoatomizdat, 1982.– 272p. 8. Kashafutdinov ST, Lushin VN Atlas of aerodynamic Wing profiles. - Novosibirsk :, 1994. - 76p. 9. Andrianov VN, Bystritsky DN, Vashkevich KP, Sectorov VR Wind power stations. - M.-L .: Gosenergoizdat, 1960. –320p. 10.Вітроенергетика [Electronic resource]: навч. way. for students. specialty 141 "Electric power, electrical engineering, electromechanics" / Golovko VM; KPI them. Igor Sikorsky. - Electronic text data (1 file: 5.5 MB). - Kyiv: KPI named after Igor Sikorsky, 2019. - 88 p. Additional:

	1.DSTU 2275-93 Energy saving. Unconventional and renewable energy sources. Terms and definitions. –K .: State Standard of Ukraine, 1994.-52p. 2.Sveshnikov AA Applied methods of the theory of random functions. –M .: Nauka, 1968. -464p. 3.Sigorsky VP Mathematical apparatus of an engineer. –K .: Technique., 1976. -768p. 4. Dubrov AM, Mkhitaryan BC, Troshin LI Multidimensional statistical methods: Textbook. - M .: Финансы и статистика, 2000. — 352с.
Type of classes	Classes are held in the form of lectures using demonstration material. Lectures are informative and problematic.
Type of semester control	Test

Discipline	Modern methods of synthesis, analysis and research of dynamic systems
Higher education degree	Third (educational - scientific)
Year	2nd year, autumn semester
Number of credits	90 hours / 3 ECTS credits
Language	Ukrainian
Department	Electromechanics
Requirements for the beginning of the study	Availability of knowledge acquired by a PhD student while studying at the first (bachelor's) and second (master's) levels of higher education. In particular, the availability of knowledge gained during the study of disciplines "Mathematical modeling of electromechanical energy converters", "Technical electrodynamics". To successfully master the discipline, the student must have a "Foreign language for scientific activities", as much of the information is presented in the scientific literature in English.
What will be studied	Modern methods of mathematical analysis (modeling) of dynamic (non-stationary) modes of operation of electromechanical energy converters (EMPE) and methods of synthesis of their parameters based on reliable simulation results.
Why it is interesting / necessary to study	The study of the methodology of analysis of dynamical systems has universal scientific and practical significance, as the learning outcomes can be used in the analysis of a wide range of physical processes occurring not only in electromechanical energy converters, but also in technical facilities
Why you can learn (learning outcomes)	After graduation, the PhD student acquires knowledge of modern techniques, algorithms and software for reliable mathematical modeling of dynamic modes of electromechanical energy converters and methods of directed synthesis of parameters of energy-efficient electromechanical complexes based on them.
How to use the acquired knowledge and skills (competencies)	The knowledge acquired during the study of the discipline can be purposefully used in the development of new and improvement of existing electromechanical energy converters for a wide range of functional purposes. Acquired competencies allow to perform mathematical analysis and synthesis of the latest energy-efficient electromechanical energy converters and electromechanical systems based on them, taking into account the peculiarities of their operation in both constant and nonlinear dynamic modes of operation.
Information support	Distance course in the Moodle system: https://do.ipo.kpi.ua/login/index.php
Type of classes	Day
Type of semester control	Offset / MCR / RGR

Discipline	Methods of rapid prototype testing of asynchronous electric drives
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Automation of electromechanical systems and electric drive
Requirements for the beginning of the study	To successfully master the discipline, the student must have a "Foreign language for research", as much of the literature on the discipline is written in English, as well as the discipline "Advanced technologies in electric drive and electromechanical systems -2".
What will be studied	Principles of construction of experimental installations on the basis of the concept of fast prototype testing for research of electromechanical systems with alternating current motors. Peculiarities of hardware and software of fast counter-testing stations are studied, their use allows to carry out practical realization of new algorithms of control of engines for time which is proportional to the time spent on mathematical modeling.
Why it is interesting / necessary to study	The concept of rapid prototype testing is used in all leading research centers and universities in the study of electromechanical systems and power electronics. Experimental research is a mandatory final stage of research and allows to test in practice the operation of control systems taking into account the effects of unmodulated dynamics, such as measurement noise, discrete information representation in digital implementation, imperfections of power semiconductors, etc. The use of the concept of rapid prototype testing allows to ensure the high quality of experimental research and to prepare theoretical results for serial implementation.
Why you can learn (learning outcomes)	Principles and circuit solutions in terms of hardware of prototype testing stations, structures on which the software is built, practical skills of implementation of control algorithms on digital signal processors, methods of experimental research of control algorithms for AC motors.
How to use the acquired knowledge and skills (competencies)	- to create experimental installations for research of control algorithms in electromechanical systems, power electronics which correspond to the leading world experience; - develop software for digital signal processors; - perform practical implementation of control algorithms for AC motors on digital signal processors; - to carry out experimental testing according to generally accepted methods, which simplifies their coverage in the scientific literature.
Information support	Syllabus, lecture notes.
Type of classes	Lectures
Type of semester control	Test

Discipline	Modern methods of synthesis, analysis and research of dynamic systems
Higher education degree	Third (educational and scientific)
Year	2nd year (3)
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Automation of control of electrotechnical complexes, IEE
Requirements for the beginning of the study	Knowledge of the theory of automatic control, methods of synthesis and analysis of SAC
What will be studied	Within the discipline the basic concepts of system analysis, methods of classification of systems, models of systems used in identification problems, parametric and nonparametric methods of identification of linear and nonlinear systems, and also methods of estimation of accuracy of the received models are considered.
Why it is interesting / necessary to study	To form a deepening of knowledge in the theory of automatic control and higher mathematics to solve problems of structural and parametric identification of systems, building control systems with dynamic objects, gaining skills in application of identification methods and application software to identify electrical systems and their elements.
Why you can learn (learning outcomes)	After studying the course, students are able to effectively apply methods of analysis, mathematical modeling, perform physical and mathematical experiments in research, integrate knowledge from other disciplines, apply a systematic approach and take into account non-technical aspects in solving engineering problems and research, justify the choice of development methods. solving a specialized task, critically evaluate the results obtained and defend the decisions made
How to use the acquired knowledge and skills (competencies)	Search, analyze and critically evaluate information from various sources, research and model phenomena and processes in complex dynamic power, electrical and electromechanical systems, apply a systems approach, integrating knowledge from other disciplines and taking into account non-technical aspects, in solving theoretical and applied problems selected field of research.
Information support	1. MIT OpenCourseWare. System Identification. - Access mode https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-435-system-identificationspring-2005/index.htm 2. System Identification Toolbox of MATLAB package - Access mode: www.mathworks.com/products/sysid/
Type of classes	Lectures
Type of semester control	Test

Discipline	Monitoring of technical risks
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Electromechanical equipment of energy-intensive industries, IEE
Requirements for the beginning of the study	Knowledge of higher mathematics, general physics, theoretical foundations of electrical engineering, theoretical mechanics, hydraulics and automation
What will be studied	- - physical foundations, theories and principles of operation of electromechanical equipment; - - features of constructive arrangement of installations and machines; - - features and order of operation of mechatronic systems; - - basics of designing mechatronic systems; - - scientific and technical directions of reducing part of manual labor, environmental protection and labor protection.
Why it is interesting / necessary to study	In order to: - technically correct and economically justified to choose installations and measure their main operating parameters; - perform calculations to determine the optimal parameters of the installation; - perform measurements and analysis of operating modes of machines using a computer.
Why you can learn (learning outcomes)	Knowledge and skills acquired in the process of studying the credit module "Technical Risk Monitoring" are necessary for each specialist in this specialty who solve engineering problems in the field of electromechanics and in the study of the following disciplines: "Automated electric drive", "Modeling…", "Fundamentals of electromechanics" »Etc.
How to use the acquired knowledge and skills (competencies)	- ability to use methods of analysis in engineering calculations; - calculate the basic parameters of electromechanical systems; - making engineering decisions on a set of issues of functioning, research of basic parameters; - computer modeling, design and operation of electromechanical equipment used in industry, transport and construction
Information support	Syllabus, https://classroom.google.com/c/MjIwMjUxOTI4MzE3?cjc=a534jai Access code: a534jai https://classroom.google.com/c/
Type of classes	lectures
Type of semester control	test

Discipline	Special issues of protection against electromagnetic effect of lightning
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian, English
Department	Theoretical electrical engineering
Requirements for the beginning of the study	Basic knowledge of general physics, theoretical foundations of electrical engineering, industrial electronics, electromagnetic compatibility of technical means. Initial ideas about the main types and characteristics of electrical equipment in electrical and other systems and installations for which the electromagnetic effects of lightning discharges can be critical.
What will be studied	Basics of protection against electromagnetic effects of lightning. Varieties and characteristics of screens. Multilayer screens. Shielding of electromagnetic fields of lightning. Induction of voltages and currents in overhead lines and cables. Shielding of the magnetic field in buildings. Separate distances and isolated lightning protection systems. Examples of protection of facilities in various industries (power plants and substations, wind power plants, photovoltaic plants, transport, oil and gas complexes, renewable energy facilities, industrial and agricultural enterprises). Active and other alternative lightning rods. Regulations.
Why it is interesting / necessary to study	Important objects in various industries are exposed to serious dangers associated with electromagnetic influences during lightning discharges, direct and near. Therefore, it is important to be able to analyze such possible effects and choose adequate means of protection against them.
Why you can learn (learning outcomes)	Navigate in dangerous situations related to the electromagnetic effects of lightning discharges on various important objects. Understand the principles of protection against them, perform calculations of induced voltages and currents, choose means of protection. Get acquainted with the relevant regulations.
How to use the acquired knowledge and skills (competencies)	Calculate the characteristics of electromagnetic and other effects of lightning on various objects. Develop and select appropriate remedies. Apply current regulations to develop protection.
Information support	Syllabus, teaching materials (manuals, presentations for lectures, etc.), standards.
Type of classes	Lectures, practical classes.
Type of semester control	Test

Discipline	General principles of construction and management of active power distribution systems
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian, English
Department	Power supply
Requirements for the beginning of the study	The course is based on the knowledge gained in the study of such disciplines as: "Electrical networks and systems", "Mathematical modulation and decision making in power supply systems", "Power distribution systems and control", "Intelligent technologies in power supply systems".
What will be studied	Problems of construction and functioning of modern and perspective systems of distribution of electric energy in the conditions of wide use of the dispersed sources of generation and accumulation of energy. Features of solving problems of modeling and optimization of distribution network modes equipped with modern switching devices, microprocessor protection and automation at different levels of information support.
Why it is interesting / necessary to study	The study of the discipline will allow to master the knowledge of building mathematical models of distribution networks, algorithms of linear and power grid equipment, the use of intelligent optimization methods and decision making in the construction and management of power distribution and consumption systems.
Why you can learn (learning outcomes)	Perform simulation modeling of distribution networks with integrated in them various dispersed means of energy generation and storage, use modern methods of optimization and decision making, get acquainted with intelligent control technologies for active power distribution systems, gain knowledge about the use of modern information control systems in electricity.
How to use the acquired knowledge and skills (competencies)	The acquired knowledge will allow to perform complex research related to the optimal use of renewable energy sources, their integration into distribution networks, to manage the modes of electricity distribution systems taking into account the requirements of the energy market; to use the gained experience for professional activity in the field of increase of efficiency and quality of power supply at designing, reconstruction, development of systems of distribution of electric energy; set and solve research tasks in these areas; ability to ensure the quality of research and rules of academic integrity in the implementation of research and implementation of scientific and pedagogical activities.
Information support	Syllabus, teaching materials (manuals, presentations for lectures, etc.), standards.
Type of classes	Lectures, practical classes.
Type of semester control	Test

Discipline 2 for study in the second year

Discipline	Mathematical modeling of Smart-systems of alternating current
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Electrical networks and systems
Requirements for the beginning of the study	The study of the discipline is based on knowledge of the following disciplines: "Methods of research, formation and management of intelligent energy systems and complexes", "Fundamentals of the theory of electromagnetic field and processes", "Unconventional and renewable energy sources in power systems and electrical complexes", "Monitoring, control and protection of electric power systems and electrotechnical complexes "," Foreign language for scientific activity ".
What will be studied	Problems of alternating current electricity transmission and their solution. Features of the formation of intelligent energy systems. Power and information and communication models of intelligent power systems.
Why it is interesting / necessary to study	The study of the discipline will allow to master the knowledge of mathematical models of construction, types and algorithms of operation of linear and power network equipment of electrical networks of alternating current; laws of intellectual management of technological processes of generation, transmission, distribution and consumption of electric energy in power systems; methods of modeling Smart-systems.
Why you can learn (learning outcomes)	Perform simulation modeling of power systems, which are presented in the form of complex AC electrical networks, including those containing intelligent connections using the most effective methods of modeling Smart-systems, calculations of operating modes of technological equipment of electrical networks, stations and substations with constituent information and communication elements.
How to use the acquired knowledge and skills (competencies)	Develop simulation models of electrical networks with elements of artificial intelligence, use of software environments MatLab and Power Factory, analysis of mode parameters of Smart-systems.
Information support	Perform simulation studies of Smart-systems of alternating current; optimally choose and apply in practice various mathematical models of elements and methods of calculation of smart grids; determine the calculated parameters of mathematical models and effectively use them in assessing the steady and post-emergency modes of operation of power systems; to determine the design parameters and optimal mode characteristics of the regulating, compensating and adjusting equipment, as well as the methodology of scientific research, to apply them in their own research in the field of electrical engineering and in teaching practice.
Type of classes	Syllabus of discipline,
Type of semester control	https://classroom.google.com/c/MTUxNDQ2MDY0NDA5?cjc=tlir677

Discipline	Methods for optimizing the study of the stability of adaptive systems
Higher education degree	Third (educational and scientific)
Year	2nd year
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Power system automation
Requirements for the beginning of the study	The course is based on the knowledge gained by students in the study of the courses "Theory of automatic control", "Transients in power", "Automatic and automated control in power systems".
What will be studied	Scientific bases on methods of optimization of research of stability of adaptive systems, bases of the theory of optimum and adaptive systems of management and data processing, the analysis of principles of construction of adaptive systems, principles of optimum estimation of parameters on discrete measurements and effective algorithms of search of estimations.
Why it is interesting / necessary to study	A characteristic feature of adaptive systems is the lack of complete a priori information about the object of control, external perturbations and boundary conditions, ie the adaptive system is characterized by uncertainty. The functioning of the system is aimed at revealing this uncertainty, ie finding a state in which a certain criterion is met. Formation of a system of abilities to set and solve complex scientific problems during research and innovation activities in the field of automation of electric power systems, deepening knowledge of the theory of automatic control to solve problems of studying the stability of adaptive systems.
Why you can learn (learning outcomes)	Apply the necessary methods of scientific research in the development of scientific papers; use special methods when performing research; organize and conduct research in the process of preparing a dissertation; to carry out approbation and implementation of research results in practice; have the skills to find independent solutions to scientific problems; choose topics for scientific work.
How to use the acquired knowledge and skills (competencies)	Ability to perform original research, to achieve scientific results that create new knowledge in the field of management of production and distribution of electricity; ability to present and discuss orally and in writing the results of scientific research in Ukrainian and English; ability to solve scientific problems of increasing the reliability and efficiency of management, protection and automation of power systems, due to the need to ensure sustainable development of the state; ability to identify, set and solve research tasks in the field of electricity generation and distribution management, evaluate and ensure the quality of research; ability to adhere to the ethics of research, as well as the rules of academic integrity in research and scientific and pedagogical activities.
Information support	1. 1. Syllabus 2. 2. Fradkov AL Adaptive control in complex systems: search methods. - M .: Nauka, 1990. - 286p. 3. 3. Pavlov BV, Soloviev IG Direct adaptive control systems. - M .: Nauka, 1989.-136p. 4. 4. Churakov EP Optimal and adaptive systems. - M .: Высш. school, 1987. - 256 p. 5. 5. Stability of adaptive systems. Per. with English / Anderson B., Bitmid R., Johnson K. and others - M .: Mir, 1989-263p. 6. 6. Dr. Kyriakos G. Vamvoudakis; Jagannathan Sarangapani - Control of Complex Systems: Theory and Applications / Springer International

	Publishing, 2017 7. 7. Christoph M. Hackl - Nin-Indetifer Based Adaptive Control in Mechatronics: Theory an Application / Springer International Publishing
Type of classes	Classes are held in the form of lectures using demonstration material. Lectures are informative and problematic.
Type of semester control	Test

Discipline	Advanced technologies in renewable energy
Higher education degree	Third (educational and scientific)
Year	2nd year
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Renewable energy sources
Requirements for the beginning of the study	The course is based on the knowledge gained by students in the study of wind energy, bioenergy, photovoltaics, solar thermal energy, geothermal energy and integrated use of renewable energy sources.
What will be studied	Scientific principles on advanced methods, organizational and technological measures of scientific research in the field of renewable energy
Why it is interesting / necessary to study	Formation of a system of abilities to set and solve complex scientific problems during research and innovation activities in the field of renewable energy.
Why you can learn (learning outcomes)	Apply the necessary methods of scientific research in the development of scientific papers; use special methods when performing research; organize and conduct research in the process of preparing a dissertation; to carry out approbation and implementation of research results in practice; have the skills to find independent solutions to scientific problems; choose topics for scientific work.
How to use the acquired knowledge and skills (competencies)	Ability to perform original research, to achieve scientific results that create new knowledge in the field of renewable energy; ability to present and discuss orally and in writing the results of scientific research in Ukrainian and English; ability to solve scientific problems of increasing the reliability and efficiency of renewable energy systems, due to the need to ensure sustainable development of the state; ability to identify, set and solve research tasks in the field of renewable energy, evaluate and ensure the quality of research; ability to adhere to the ethics of research, as well as the rules of academic integrity in research and scientific and pedagogical activities.
Information support	1.Sylabus. 1. Renewable energy sources / Ed. S.O. Curls. - Kyiv: Institute of Renewable Energy of NASU, 2020. - 392 p. 2. Unconventional and renewable energy sources / Kudrya SO - Textbook. - Kyiv: National Technical University of Ukraine (KPI), 2012. – 495p. 3. Atlas of energy potential of renewable energy sources in Ukraine / ed. S.O. Curls. - Kyiv: Institute of Renewable Energy of the National Academy of Sciences of Ukraine, 2020. - 82 p. 4. Karmazin OO Balance reliability of electric power systems in the conditions of growth of a share of renewable power: dis. for science. degree of Cand. tech. Sciences: 14.08.2019 / Karmazin Alexey Alexandrovich - K., 2019. - 143 p. 5. Budko VI The use of solar radiation and wind energy for charging electric vehicles: dis. for science. degree of Dr. tech. Sciences: 14.08.2019 / Budko Vasily Ivanovich - K., 2019. - 302 p. 6. Вітроенергетика [Electronic resource]: навч. way. for students. specialty 141 "Electric power, electrical engineering, electromechanics" / Golovko VM; KPI them. Igor Sikorsky. - Electronic text data (1 file: 5.5 MB). - Kyiv: KPI named after Igor Sikorsky, 2019. - 88 p. Additional: 1. DSTU 2275-93 Energy saving. Unconventional and renewable energy sources. Terms and definitions. –K .: State Standard of Ukraine, 1994.-52p. 2. Requirements for wind and solar power plants during their operation in

	parallel with the unified energy system of Ukraine: SOU NEK 341.001: 2019. NEK Ukrenergo, 2019.
Type of classes	Classes are held in the form of lectures using demonstration material and practical classes. Lectures are informative and problematic.
Type of semester control	Test

Discipline	Modern methods and models of analysis of regime reliability of electric power systems
Higher education degree	Third (Doctor of Philosophy)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Renewable energy sources
Requirements for the beginning of the study	theory of electromagnetic transients and electromechanical processes in the power system, calculation of steady-state modes, basics of operation and modes of operation of the electrical part of stations and substations, control of power plants and systems, theory of electric machines, reliability of power systems, basics of relay protection and automation of power systems. Intelligent methods for assessing the technical condition of electrical equipment.
What will be studied	Basic provisions and formulation of reliability indicators in the power industry. Factors reducing the reliability of modern power systems. The impact of liberalization in the power industry on the reliability of power systems. Technical condition and operating conditions of modern electrical equipment with power plants of different types. Features of operation and tasks of ensuring the reliability and safety of NPPs in case of equipment failures Cascade development of emergency processes in the NPP. Characteristics of cascade accident scenarios in the world power industry. Economic mechanisms to ensure the reliability and survivability of the power system. Characteristics of the problem of ensuring the balance reliability of the power system. Indicators of balance reliability of EES Tasks of ensuring regime reliability of EES. Static mode reliability taking into account the development of failures. Estimation and management of static mode reliability. Dynamic mode reliability taking into account the development of accidents. Operating modes of EES in case of electrical equipment failures. Analysis of regime reliability of UES by methods of risk theory Methods and models of operational risk assessment of electric power facilities. Determining the priority of decommissioning of electrical equipment. Decision making in conditions of risk. Probabilistic and statistical methods for assessing the regime reliability of the power system. Quantitative indicators of the risk of violation of the normal regime in the event of electrical equipment failures Assessment of the risk of electrical equipment failure in the event of disturbances in the external electrical network. Modeling and risk assessment of NPP power supply system failure from external energy sources.
Why it is interesting / necessary to study	Liberalization of the power industry, and the increase in the world in recent decades of major systemic accidents exacerbates the problem of ensuring the reliability of power systems with power plants of various types; this requires students to master the principles and methods of building models of electrical equipment failures, the methodology of simulation research of regime reliability, analysis and risk management in the EEC, methods of preventive decisions to reduce operational risks in the EEC.
Why you can learn (learning outcomes)	select and develop new models for determining the probability of failure of electrical equipment using modern IT-technologies, investigate emergency modes and quantify the risk of normal failure in case of failure and decommissioning of electrical equipment, develop preventive measures to minimize the risk of operation of electrical equipment and complex power plants.
How to use the acquired knowledge	**the student will be able to:** **- apply the basic provisions of systems theory for the analysis of processes in**

and skills (competencies)	**the power system with power plants of different types;** **- use modern information technologies to develop models for assessing the risk of failure of electricity facilities;** **- apply the principles and methods of simulation for the study of emergency modes of power systems in case of failure of electrical equipment;** **- perform calculations and analysis of electromechanical transients in the UES with the NPP; assess the risk of failure of the NPP power supply system.** **- assess the regime reliability of EES subsystems on the basis of probabilistic and statistical determination of emergency risk indicators;** **- make optimal decisions to minimize the risk of accidents in the subsystems of the UES based on a risk-oriented approach.**
Information support	Training and working programs of the discipline, RSO, teaching materials (lecture notes, computer workshops), guidelines for computational and graphic work, computer workshops
Type of classes	computer workshops, modular control work, calculation and graphic work
Type of semester control	Offset.

Discipline	Fundamentals of system electromechanics
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Electromechanics
Requirements for the beginning of the study	Prerequisites for studying the discipline are the results of studying and mastering previous disciplines: "Modeling of electromechanical systems", "Fundamentals of the theory of structures of electromechanical systems", "Fundamentals of innovative synthesis of electromechanical systems", "Fundamentals of research".
What will be studied	System-forming principles that determine the structural organization and coevolution of electromechanical energy converters with the possibility of their systematization and scientific prediction.
Why it is interesting / necessary to study	The development of science and the creation of competitive electromechanical systems is impossible without knowledge of fundamental principles and the use of systems approaches in the organization of scientific research. The amount of professional knowledge outlined only by the classical disciplines of one technical specialty or specialization is no longer sufficient for the formation of a modern scientific worldview of the applicant and conducting research at the interdisciplinary level in reality.
Why you can learn (learning outcomes)	The main learning outcomes are aimed at obtaining professional, systemic, innovative, prognostic, humanitarian, cognitive and interdisciplinary competencies of applicants.
How to use the acquired knowledge and skills (competencies)	Applicants can effectively use the acquired knowledge and competencies in the preparation of their dissertations, in the organization of basic and interdisciplinary research, in the creation of complex electromechanical systems with subsystems of other physical nature (mechanical, electronic, hydraulic, aerodynamic, biological, etc.).
Information support	Syllabus, lecture notes, description of the discipline, list of literature that are posted on information platforms: https://do.ipo.kpi.ua/course/view.php?id=4149 https://campus.kpi.ua/tutor/index.php?mode=mob&ir_own
Type of classes	Classroom / distance / mixed (lectures, practical, seminar).
Type of semester control	Test.

Discipline	Identification of parameters in electromechanical systems
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Automation of electromechanical systems and electric drive FEA
Requirements for the beginning of the study	General knowledge of mathematics, theory of automatic control, English
What will be studied	The subject of the discipline "Identification of parameters in electromechanical systems" is the study of the theory of adaptive control, the application of its methods for the construction of modern adaptive electromechanical systems. The course includes the study of principles and algorithms for identifying the parameters of electromechanical systems for their automatic self-tuning, estimation of unmeasured coordinates with the help of adaptive observers and by direct adaptive control. Identification of electrical and mechanical parameters of electromechanical objects with fully and partially measured state vector.
Why it is interesting / necessary to study	The study of this discipline is important for the construction of modern electric drives and electromechanical systems, which, according to existing standards, must be equipped with adaptive control functions such as: identification of parameters for initial system initialization and subsequent self-tuning procedure. This knowledge is also needed for the development and research of new electromechanical systems.
Why you can learn (learning outcomes)	To develop and study electric drives of alternating current and electromechanical systems of wide technological purpose with properties of adaptation and robustness to parametric and coordinate perturbations.
How to use the acquired knowledge and skills (competencies)	The acquired knowledge will help the future scientist to freely create modern electromechanical automation systems for a wide range of technological applications. To be the responsible executor on development of algorithms of management of electric drives, electromechanical and electrotechnical systems. Perform research in the field of technology of modern control systems.
Information support	Curriculum and working programs of the discipline, RSO, English-language sources.
Type of classes	Lectures and practical classes.
Type of semester control	Test

Discipline	Mathematical modeling of power systems and electrical complexes
Higher education degree	Third (educational and scientific)
Year	2nd year (4)
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Automation of control of electrotechnical complexes, IEE
Requirements for the beginning of the study	Knowledge of the theory of automatic control of electrotechnical complexes, energy saving in electrotechnical systems, modeling of electrotechnical complexes
What will be studied	Mathematical modeling of energy modes of operation of electrical complexes - load unit, semiconductor converter, electromechanical converter, mechanical converter, executive body. Simulation and optimization mathematical models of electrical complexes. Implementation of energy efficient modes of operation of electrical systems.
Why it is interesting / necessary to study	To form in young scientists the skills of independent design and research work, which involves perfect mastery of the theory and technique of modeling of various complex electromechanical systems. The discipline focuses on the use of modern application software in solving various scientific and technical problems.
Why you can learn (learning outcomes)	After studying the course, young scientists are able to produce new ideas (creativity); able to search, process and analyze information from various sources; capable of professional formulation and solution of complex multicriteria optimization problems, to the implementation of energy-efficient modes of operation of electrical complexes.
How to use the acquired knowledge and skills (competencies)	Formulation of verbal optimization algorithms, formalization of verbal algorithms. Creation of simulation and mathematical models of optimization of control modes and selection of electrical equipment of electrical complexes. Possession of methods for assessing the energy efficiency of the complex.
Information support	1. MIT OpenCourseWare. System Identification. - Access mode https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-435-systemidentification-spring-2005/index.html 2. System Identification Toolbox package MATLAB. - Access mode: www.mathworks.com/products/sysid/
Type of classes	Lectures, practical classes
Type of semester control	Test

Discipline	Methods and means of measuring physical quantities
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian
Department	Electromechanical equipment of energy-intensive industries, IEE
Requirements for the beginning of the study	The discipline "Methods and means of measuring physical quantities" is taught on the basis of knowledge and skills acquired by students during the study of such disciplines as "Methods of research, formation and management of intelligent energy systems and complexes", "Unconventional and renewable energy sources in power systems and electrical complexes","Monitoring, control and protection of electric power systems and electrotechnical complexes",
What will be studied	The subject of study of the discipline "Methods and means of measuring physical quantities" is the formation of theoretical knowledge and practical skills in metrology as a scientific basis for measuring equipment, the level of knowledge about methods of measuring technological parameters and signals, principles of modern systems and automatic control devices during experimental research. .
Why it is interesting / necessary to study	The study of the discipline will allow specialists in the field of power engineering, electrical engineering and electromechanics to use the acquired knowledge to solve scientific problems of varying complexity
Why you can learn (learning outcomes)	The subject of the initial discipline is: - Electromechanical measuring transducers and devices. - Electronic analog devices. - Digital measuring instruments. - Measurement of magnetic quantities. -Features of measurement of non-electric quantities. - Measurement of non-electrical quantities. - Microprocessor systems in measuring technology. - Information and measuring systems.
How to use the acquired knowledge and skills (competencies)	The result of studying the discipline is the formation of students' abilities: - process measurement results, detect and eliminate systematic errors, plan and organize a measurement experiment; - make fundamental decisions regarding the measurement of physical quantities, use measuring equipment, - to calculate parameters of devices, to develop non-standard primary and combined converters for measurement of technological parameters; - choose the method of measuring the parameter or signal, the device that implements this method and the measurement limits of the device, - perform calibration and calibration, calculate the parameters of devices for partitioning to a new measuring range, diagnose the serviceability of devices and automatic control systems.
Information support	1. Syllabus, http://emoev.kpi.ua/author/Zstefan/ів 2. Golovko DB Fundamentals of metrology and measurements / DB Golovko, KG Rego, Yu.O. Violinist. - К .: Либідь, 2001. - 248 с. 3. Polishchuk ES Metrology and measuring equipment (edited by E. Polishchuk). / E.C. Polishchuk, MM Dorozhovets, VO Yatsuk and others. - Lviv: Beskyd BIT, 2003. - 544p.
Type of classes	Lectures, practical classes
Type of semester control	Test

Discipline	Analysis and research of development of lightning discharge channel as dynamic system
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	4 ECTS credits
Language	Ukrainian, English
Department	Theoretical electrical engineering
Requirements for the beginning of the study	Basic knowledge of general physics, theoretical foundations of electrical engineering, industrial electronics, electromagnetic compatibility of technical means. Initial ideas about the main types and characteristics of electrical equipment in electrical and other systems and installations for which the electromagnetic effects of lightning discharges can be critical.
What will be studied	Fundamentals of atmospheric electric discharges of different types and related electromagnetic fields, currents and voltages. Dangerous effects from direct and indirect (in particular, induced) lightning actions. Statistics on lightning parameters and methods of recording their characteristics. Methods and means of protection of buildings, electrical systems and equipment from hazardous effects associated with lightning discharges. Human and animal safety issues. Normative documents on lightning protection and means of protection of buildings, power and electronic equipment. Protection of electrical networks, data transmission systems. Features of protection of overhead and cable power lines. Selection and application of protective devices to limit overvoltages and high currents. Lightning rods. Grounding systems. Examples of lightning protection of various objects. Practical development of lightning protection systems for various objects, selection of components.
Why it is interesting / necessary to study	Buildings, electrical systems, people, various structures, installations and equipment in the conditions of thunderstorm activity are exposed to the danger associated with various effects of lightning. There is a special danger for expensive station equipment in the energy sector, oil refining facilities, explosives-related industries, and modern electronic devices that are sensitive to even minor electromagnetic influences. Therefore, most facilities, electrical and other engineering networks, equipment in almost all industries require the development and installation of protection systems against direct and indirect lightning.
Why you can learn (learning outcomes)	Focus on issues of protection against the dangerous effects of lightning for buildings and electrical and other systems that relate to various industries and are important for many specialties and specializations. Perform practical development of lightning protection systems, reasonably select the necessary components for its implementation.
How to use the acquired knowledge and skills (competencies)	Assess hazards associated with lightning impacts on various facilities (including energy, including renewables). Analyze existing and develop new lightning protection systems for various objects, in accordance with current regulations. Perform calculations of lightning protection systems and reasonably choose the components of these systems and surge protection devices in electrical systems.
Information support	Syllabus, teaching materials (manuals, presentations for lectures, etc.), standards.
Type of classes	Lectures, practical classes.
Type of semester control	Test

Discipline	Application of power electronics in active power distribution systems
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	3 ECTS credits
Language	Ukrainian, English
Department	Power supply
Requirements for the beginning of the study	The course is based on the knowledge gained in the study of such disciplines as: "Power electronics systems and controls in the power industry", "System analysis of complex systems of electricity supply to consumers", "Electrical networks and systems", "Electricity distribution systems and control" , "Intelligent technologies in power supply systems".
What will be studied	General characteristics, principles of work and prospects of involvement of means of power electronics at construction and management of functioning of active systems of distribution of electric energy. Features of the use of power electronics devices to increase the reliability of power supply, ensure the quality of electricity, reactive power compensation and control the flow of active power (soft open points technology) in order to minimize electricity losses.
Why it is interesting / necessary to study	The study of the discipline will allow: to acquire knowledge about the construction, principles of operation and features of the use of power electronics in distribution networks; gain the ability to justify the location of these tools and master the methods of rational management of their work to ensure optimal modes of distribution and consumption of electricity, taking into account a set of technical and economic criteria.
Why you can learn (learning outcomes)	Perform simulation modeling of distribution networks with integrated in them various dispersed means of energy generation and storage and equipped with modern power electronics devices, use modern methods of optimization and decision making in centralized and decentralized control of active power distribution systems in the use of power.
How to use the acquired knowledge and skills (competencies)	The received knowledge will allow to carry out the complex researches connected with optimum use of means of power electronics in the conditions of wide introduction of renewable energy sources in distribution networks, to operate modes of systems of distribution of the electric power; use the experience gained in the use of power electronics to improve the efficiency and quality of power supply in the design, reconstruction, development of power distribution systems; set and solve research tasks in these areas; to ensure the quality of scientific research and compliance with the rules of academic integrity in the implementation of scientific and pedagogical activities.
Information support	Syllabus, teaching materials (manuals, presentations for lectures, etc.), standards.
Type of classes	Lectures, practical classes.
Type of semester control	Test

Discipline 3 for study in the second year

Discipline	Monitoring and diagnostics of electric power systems
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	4 ECTS credits
Language	Ukrainian
Department	Electrical networks and systems
Requirements for the beginning of the study	The study of the discipline is based on knowledge of the following disciplines: "Methods of research, formation and management of intelligent energy systems and complexes", "Fundamentals of the theory of electromagnetic field and processes", "Unconventional and renewable energy sources in power systems and electrical complexes", "Monitoring, control and protection of electric power systems and electrotechnical complexes ".
What will be studied	General characteristics of monitoring in the power industry. Algorithms and measuring channels of monitoring in the power system. Information and diagnostic complexes.
Why it is interesting / necessary to study	The study of the discipline will allow to professionally monitor the modes of operation of AC networks, diagnose the state of electrical installations of electrical networks; analysis of monitoring parameters of electric power systems and networks, normative bases of monitoring, bases of monitoring measurement, organization of monitoring software and hardware.
Why you can learn (learning outcomes)	Monitor modes of operation of AC networks; perform diagnostics of the state of electrical installations of electrical networks; analysis and conversion of measured values by monitoring mode parameters.
How to use the acquired knowledge and skills (competencies)	Evaluate and analyze monitoring objects, monitoring indicators, monitoring factors and monitoring indicators; use software and hardware for monitoring and diagnostics of electrical networks. Develop structural schemes and algorithms for monitoring the parameters of power systems and networks, plan and perform monitoring of operating parameters of AC systems and tangential intersystem directions using modern software and hardware, understand the general principles and methods of engineering, as well as methodology for monitoring and diagnostics. in their own research in the field of electrical engineering and in teaching practice.
Information support	Syllabus of discipline, https://classroom.google.com/c/MTUxNDQ0MzY5NTIz?cjc=lhpaht5
Type of classes	Lectures
Type of semester control	Examination

Discipline	Methods of analysis and research of complex dynamical systems
Higher education degree	Third (educational and scientific)
Year	2nd year
Number of credits	4 ECTS credits
Language	Ukrainian
Department	Power system automation
Requirements for the beginning of the study	The course is based on the knowledge gained by students in the study of courses "Theoretical foundations of electrical engineering", "Electrical machines", "Electrical networks and systems", "Transients in power engineering", "Theory of automatic control"
What will be studied	Scientific principles on methods, organizational and technological measures of scientific research in the field of complex dynamic systems, methods of system analysis, qualitative and quantitative methods of description of complex systems, principles and methods of control in complex control systems.
Why it is interesting / necessary to study	Development of understanding of the essence of methods of mathematical modeling and optimization of complex technical systems, obtaining skills of construction and research of models that describe complex technological processes; development of abilities to apply methods of system analysis, synthesis and control technologies for conducting research in the field of electric power.
Why you can learn (learning outcomes)	Gain an understanding of the concept of complex systems; Identify the parameters of management models; Ability to make scientifically sound decisions based on methods of systems analysis and management theory; Ability to develop methods of modeling, analysis and technology of synthesis of processes and systems in the field of technical systems; Apply the necessary methods of scientific research in the development of scientific papers; use special methods when performing research; organize and conduct research in the process of preparing a dissertation; to carry out approbation and implementation of research results in practice; have the skills to find independent solutions to scientific problems; choose topics for scientific work.
How to use the acquired knowledge and skills (competencies)	Ability to perform original research, to achieve scientific results that create new knowledge in the field of management of production and distribution of electricity; ability to present and discuss orally and in writing the results of scientific research in Ukrainian and English; ability to solve scientific problems of increasing the reliability and efficiency of management, protection and automation of power systems, due to the need to ensure sustainable development of the state; ability to identify, set and solve research tasks in the field of electricity generation and distribution management, evaluate and ensure the quality of research; ability to adhere to the ethics of research, as well as the rules of academic integrity in research and scientific and pedagogical activities.
Information support	1.Sylabus. 2. Fundamentals of control theory in simple and complex systems: a textbook / Voronezh, 2005 - 181 p. 3. Klimenko, IS Systems theory and system analysis / Klimenko IS— M .: Russian New University, 2014.— 264 p. 4. Modeling and analysis of dynamic systems Charles M. Close and Dean K. Frederickand Jonathan C. Newell-3rd ed. 5. Modeling and Analysis of Dynamic Systems, Second Edition / Ramin S. Esfandiari, Bei Lu, 2014, 558p.
Type of classes	Classes are held in the form of lectures using demonstration material. Lectures

	are informative and problematic.
Type of semester control	Examination

Discipline	Promising technologies for combined use of renewable energy sources
Higher education degree	Third (educational and scientific)
Year	2nd year
Number of credits	4 ECTS credits
Language	Ukrainian
Department	Renewable energy sources
Requirements for the beginning of the study	The course is based on the knowledge gained by students in studying the course of integrated use of RES.
What will be studied	Scientific principles on methods, organizational and technological measures of scientific research in the field of renewable energy in relation to systems with integrated application of RES.
Why it is interesting / necessary to study	Formation of a system of abilities to set and solve complex scientific problems during research and innovation activities in the field of renewable energy.
Why you can learn (learning outcomes)	Apply special methods when performing research; organize and conduct research in the process of preparing a dissertation; to carry out approbation and implementation of research results in practice; have the skills to find independent solutions to scientific problems.
How to use the acquired knowledge and skills (competencies)	Ability to perform original research, achieve scientific results that create new knowledge in the field of renewable energy, and use the acquired knowledge for professional activities; ability to solve scientific problems to increase the reliability and efficiency of energy systems and complexes focused on sustainable development of the state; ability to identify, set and solve research tasks in the field of renewable energy, evaluate and ensure the quality of research; ability to adhere to the ethics of research, as well as the rules of academic integrity in research and scientific and pedagogical activities.
Information support	1. 1. Syllabus. 2. 2. Unconventional and renewable energy sources / Kudrya SO - Textbook. - Kyiv: NTUU (KPI), 2012. – 495p. 3. 3. Renewable energy sources / Ed. S.O. Curls. - Kyiv: IVE NASU, 2020. - 392 p. 4. 4. Velichko SA Energy of the environment of Ukraine (with electronic maps). Educational and methodical manual for undergraduates. - Kharkiv: VNKarazin Kharkiv National University. - 2003. - 52p.– 2006. - 280 p. 5. 5. Alternative energy sources of Ukraine: textbook. manual / IOKovalyov, OV Town Hall. - Sumy: SSU Publishing House, 2015. - 201 p. 6. 6. Velkin VI Methodology for calculating complex RES systems for use on autonomous facilities. Ekat .: UrFU, 2015. 226 p. 7. 7. Billington R., Allan R. Evaluation of the reliability of power systems; lane. with English. Moscow: Energoatomizdat, 1988. 287 p. 8. 8. Lukutin BV, Muravlev IO, Plotnikov IA Power supply systems with wind and solar power plants: a textbook - Tomsk: Tomsk Polytechnic Publishing House. University, 2015. - 128 p. 9. 9. Complex use of renewable energy sources [Electronic resource]: a course of lectures for students. specialty 141. https://classroom.google.com/c/MjUxOTY2OTAxNjI2?cjc=ul2xsb6. 10. Additional: 11. 1. DSTU N B B.1.1-27: 2010 Protection against dangerous geological processes, harmful operational influences, fire. Construction climatology

	- Kyiv: Ministry of Regional Development of Ukraine, 2011.-123p. 12. 2. SOU NEK 341.001: 2019. Requirements for wind and solar power plants in their operation in parallel with the unified energy system of Ukraine .. Kyiv, 2019. - 33 p. 3. Theory of probabilities and its engineering applications: a textbook / ES Wentzel, L.A. Ovcharov. - 5th ed., P. - Москва: ЮСТИЦИЯ, 2018. - 480 с.
Type of classes	Classes are held in the form of lectures using demonstration material. Lectures are informative and problematic.
Type of semester control	Examination

Discipline	Intelligent methods for assessing the technical condition and service life of electrical equipment.
Higher education degree	Third (Doctor of Philosophy)
Year	2
Number of credits	4 ECTS credits
Language	Ukrainian
Department	Renewable energy sources
Requirements for the beginning of the study	General knowledge of computer science, theory of transients in the power system,, basics of operation and modes of operation of electrical equipment and power plants, control modes of power plants, theory of electrical machines and transformers, electrical devices, basics of relay protection and automation of power systems, theory of power system reliability,
What will be studied	Methodical bases of a complex estimation of a technical condition of the electric equipment. Problems and tasks of assessment of vehicles of modern electrical equipment, existing strategies for maintenance and repair of electrical equipment. Assessment of the technical condition of electrical equipment on a set of controlled parameters. Generalized model of equipment resource consumption taking into account operational factors. Deterministic models for determining the spent resource of power and switching equipment of power systems. Modern concepts of information systems for diagnostics of electrical equipment. The main types and directions of development of systems of technical diagnostics of electric equipment of power systems. Tasks of technical diagnostics in electric power industry. Features of assessment of technical condition of electrical equipment. Intelligent technologies in the tasks of diagnosing vehicles of electrical equipment. Application of fuzzy set theory, fuzzy logic, fuzzy knowledge bases for vehicle evaluation. Basic concepts of artificial neural networks (ANN) and their use in the problems of identification of electrical equipment. Segmentation of electrical equipment by cluster analysis. Adaptation of neuron-fuzzy models of evaluation of TC electrical equipment, Setting of fuzzy knowledge bases for state classification tasks, application of genetic algorithms for setting up linguistic models of evaluation of TC equipment and training of neural networks, algorithms and methods of training artificial neural networks. . Setting up fuzzy knowledge bases Mamdani and Sugeno. Modern methods of forecasting the vehicle and the resource of electrical equipment Problems and tasks of ensuring reliable forecast of the vehicle and the resource of electrical equipment of power systems, Characteristics of existing traditional forecasting methods, Forecasting the resource and mode parameters of power facilities using ANN. Linguistic models of assessment of vehicles and resource of power and switching equipment of power systems, Formation of a hierarchical structure of a fuzzy logical conclusion about the technical condition of electrical equipment,
Why it is interesting / necessary to study	Objectively existing today, a significant level of wear of electrical equipment of modern power systems leads to an increase in the probability of their failure, the risk of accidents in the UES, an important task is the correct choice of management strategy electrical equipment based on the use of modern information technology, making optimal decisions to extend its service life or replacement.
Why you can learn (learning outcomes)	select and create new models for assessing the technical condition and service life of electrical equipment using modern IT-technologies .; to form a strategy for managing the technical condition of equipment, taking into account the results of diagnosis; Develop models of electrical equipment failures for the analysis of

	regime reliability and risks in the UES.
How to use the acquired knowledge and skills (competencies)	the graduate student will be able to: 1. Have a modern methodology for comprehensive assessment of vehicles and strategies for maintenance and repair of electrical equipment; 2. To choose the most informative diagnostic signs of a condition of the electric equipment, to carry out formalization of heuristic and expert information; 3.Develop new models for assessing the technical condition of electrical equipment using modern information technology; 4. Carry out the adaptation of linguistic models to real operating conditions; 5..Apply modern methods of forecasting the technical condition and resource of electrical equipment to select the optimal strategy for its operation.
Information support	Curriculum and working programs of the discipline, RSO, teaching materials (lecture notes, computer workshops, guidelines for studying the discipline and computer workshops).
Type of classes	computer workshops, modular control work, home control work.
Type of semester control	Examination

Discipline	Diagnosis and optimization of operation of electromechanical energy converters and complexes based on them
Higher education degree	Third (educational - scientific)
Year	2nd year, spring semester
Number of credits	90 hours / 3 ECTS credits
Language	Ukrainian
Department	Electromechanics
Requirements for the beginning of the study	Availability of knowledge acquired by a PhD student while studying at the first (bachelor's) and second (master's) levels of higher education. In particular, the availability of knowledge gained during the study of disciplines "Diagnostics and maintenance of electric machines", "Electric machines of automation systems". To successfully master the discipline, the student must have a "Foreign language for scientific activities", as much of the information is presented in the scientific literature in English.
What will be studied	Postgraduate students study modern approaches to improving the functioning of electromechanical complexes, development of the latest elemental base with the participation of digital computers, electronic digital converters and development of methods for diagnosing the main components of the whole complex.
Why it is interesting / necessary to study	The practice of operation of electromechanical complexes is an important task of the national economy of Ukraine. Mastering the principles of increasing the level of operation of complex technical systems based on electromechanical energy converters, requires a transition to a higher level of awareness of the specialty 141 "Electric power, electrical engineering and electromechanics". The need for specialists of high scientific level to ensure the reliability of electromechanical complexes using modern diagnostic methods, causes the state's need for specialists of modern scientific level
Why you can learn (learning outcomes)	After graduation, the PhD graduate acquires knowledge of modern methods of diagnosing electromechanical equipment and complex systems. Master the structure of modern electromechanical complexes, which consist of electromechanical energy converters, IGBT inverters and digital electronics
How to use the acquired knowledge and skills (competencies)	The knowledge acquired during the study of the discipline can be used in the development of new methods and hardware for diagnosing complex electromechanical systems, reasonably compose and build complexes based on electromechanical energy converters and increase the efficiency of their operation
Information support	Distance course in the Moodle system: https://do.ipo.kpi.ua/login/index.php
Type of classes	Day
Type of semester control	Offset / MCR / RGR

Discipline	Methods for studying the stability of adaptive observers
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	4 ECTS credits
Language	Ukrainian
Department	Automation of electromechanical systems and electric drive FEA
Requirements for the beginning of the study	General knowledge of mathematics, theory of automatic control, English
What will be studied	The subject of the discipline "Methods of studying the stability of adaptive observers" is to study the scientific basis of modern stability theory in adaptive control problems to build modern electric drives and electromechanical systems, electrical systems and systems with adaptive and robust properties to parametric and coordinate perturbations. The course includes the study of basic principles of construction of algorithms for identification of parameters of control objects in electromechanics and electrical engineering, estimation and compensation of disturbances by means of adaptive observers. It is supposed to consider methods of proving stability on the basis of Lyapunov's theory in systems with fully and partially measurable state vector. The principal problems on automatic determination of inductances and active resistances of typical links, windings of electric machines, identification of moments of inertia, estimation of perturbations, construction of state observers for estimation of flux couplings, currents, angular velocity will be considered.
Why it is interesting / necessary to study	The study of this discipline is important for the development and study of new adaptive electromechanical and electrotechnical systems based on adaptive observers. The current level of requirements for automation systems can not be met without the provision of adaptation functions, which determines the relevance of the study of the discipline.
Why you can learn (learning outcomes)	To study the basics of the theory of adaptive and robust control, its application for analytical synthesis of adaptive observers of advanced electromechanical systems of the next generations. It is assumed to determine the methods of proving stability in systems with fully and partially measurable state vector.
How to use the acquired knowledge and skills (competencies)	The acquired knowledge will help the future scientist to freely create modern electromechanical automation systems for a wide range of technological applications with the properties of adaptation to parametric perturbations, as well as in the conditions of partial measurement of state variables. To be a responsible executor in scientific institutions for the development and research of the latest complex automatic control systems.
Information support	Curriculum and working programs of the discipline, RSO, English-language sources.
Type of classes	Lectures and practical classes.
Type of semester control	Examination

Discipline	Methods of pattern recognition in electrical systems
Higher education degree	Third (educational and scientific)
Year	2nd year (4)
Number of credits	4 ECTS credits
Language	Ukrainian
Department	Automation of control of electrotechnical complexes, IEE
Requirements for the beginning of the study	The discipline is taught on the basis of knowledge and skills acquired by students during the study of credit modules of such disciplines as "Higher Mathematics", "Mathematical Methods of Optimization", "Computer Science and Programming", "Statistical Modeling of Electromechanical Systems", etc.
What will be studied	Pattern recognition methods will detect, predict, classify faults and make decisions that are important functions integrated into the implementation of protection schemes to develop a more intelligent transmission system. Electromechanical, electronic, digital, digital relays, and today intelligent relays are a trend in the field of protection of power systems and, in some cases, protection schemes of power lines. The decision model contains an idea of the nonlinearity of the mapping between the input vector and the output target. Therefore, the method of pattern recognition is considered one of the most important milestones in complex and nonlinear problems, such as the protection of power systems.
Why it is interesting / necessary to study	To form in young scientists the knowledge and practical skills of using pattern recognition theory in the field of power engineering, electrical engineering and electromechanics. The study of the material of this discipline is exclusively focused on the widespread use of computer technology and programming.
Why you can learn (learning outcomes)	The result of studying the discipline is the formation of students' abilities: -fault detection, - fault classification or phase selection, - fault detection with high resistance, - Detection of symmetrical faults during power oscillation and detection of power oscillation are functions developed using image recognition methods.
How to use the acquired knowledge and skills (competencies)	After studying the course, young scientists are able to produce new ideas (creativity); able to search, process and analyze information from various sources; are able to properly use specialized software packages to classify faults in electrical systems; able to correctly select and use the optimal functions of specialized application packages to achieve the optimal solution; are able to correctly choose and use image recognition methods in control systems to achieve the optimal solution.
Information support	1. https://wikipedia.org 2. YagangZhang, YutaoLiu, Xiaozhe, "Faultpattern recognition in power system engineering," 2009, Chengdu, 2009, pp. 109-112, doi: 10.1109 / ICIMA.2009.5156572. 3. Gorelik AL,. Recognition methods / AL Gorelik, VA Skripkin - 4th ed. - M .: Высшая школа, 1984, 2004. - 262 с. 4. Fomin Ya. A. Pattern recognition: theory and applications. - 2nd ed. - M .: ФАЗИС, 2012. - 429 с
Type of classes	Lectures, practical classes
Type of semester control	Examination

Discipline	Identification of nonlinear dynamical systems
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	4 ECTS credits
Language	Ukrainian
Department	Electromechanical equipment of energy-intensive industries, IEE
Requirements for the beginning of the study	The discipline "Identification of nonlinear dynamical systems" refers to the cycle of training a doctor of philosophy, based on knowledge and skills of fundamental sections of mathematics, physics, electrical engineering, electromechanics and mechatronics, programming, mathematical modeling of electromechanical systems and others taught in the training cycle. chosen profession.
What will be studied	Structure, functions and criteria for determining nonlinear electromechanical and mechatronic dynamical systems. Identification algorithms based on Runge-Kutt, Euler methods for solving problems of research of discrete models of nonlinear dynamic processes and algorithms for identification of continuous models based on the finite difference method. Modern methods of programming in MathCAD and AutoCAD systems (in AutoLISP) solutions of problems of identification of nonlinear dynamic systems.
Why it is interesting / necessary to study	The discipline lays the foundations for deepening knowledge for research within the tasks facing the research university: modeling of electromechanics for research and development work in preparation for the dissertation of a doctor of philosophy with the use of mathematical modeling; CAD - technologies, modern information systems and databases, software, multimedia systems and Internet technologies, design methodologies and CAD elements of nonlinear dynamic systems.
Why you can learn (learning outcomes)	The result of studying the discipline is the formation of abilities: - to form calculation schemes and discrete and continuous models of nonlinear dynamic processes in the field of electromechanics and mechatronics; - to study the motion of elements of nonlinear discrete models by the method of phase coordinates; - to develop and apply identification algorithms based on Runge-Kutt and Euler methods to solve problems of research of discrete models of nonlinear dynamic processes; - to develop and apply algorithms for identification of continuous models based on the finite difference method; - to use modern programming methods in MathCAD and AutoCAD (AutoLISP) systems for solving problems of identification of nonlinear dynamic systems.
How to use the acquired knowledge and skills (competencies)	In order to conduct research on the topic of the dissertation, to analyze dynamic systems, determine their complexity and justify the choice of methods for their identification. To determine the optimal parameters and characteristics of the studied nonlinear dynamical system, apply numerical simulation methods using the finite difference method and integrate differential equations into partial derivatives of the hyperbolic type. For the synthesis of structural elements of nonlinear dynamic systems, use methods of forming structural and computational schemes, their mathematical analogues and methods of identification with programming in modern information systems.
Information support	Syllabus, https://do.ipo.kpi.ua/course/view.php?id=2522

Type of classes	Lectures, practical classes
Type of semester control	Examination

Discipline	Mathematical modeling of systems of protection of electrotechnical complexes against electromagnetic effects of lightnings
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	4 ECTS credits
Language	Ukrainian, English
Department	Theoretical electrical engineering
Requirements for the beginning of the study	Basic knowledge of general physics, theoretical foundations of electrical engineering, industrial electronics, electromagnetic compatibility of technical means. Initial ideas about the main types and characteristics of electrical equipment in electrical and other systems and installations for which the electromagnetic effects of lightning discharges can be critical.
What will be studied	Methods and means of registration of lightning characteristics: fact, place and time of occurrence of atmospheric electric discharges and shocks, parameters of pulse and long currents, charges, electromagnetic fields, etc. Lightning discharge models to justify the choice of the necessary algorithms and characteristics of automated systems and means of registration. Registration of lightning characteristics on tall buildings, power lines, wind power plants and other facilities. Lightning activity warning systems. Remote lightning detection systems. Research with artificially initiated lightning. Regulations. Analysis of these registration systems and recommendations for their use.
Why it is interesting / necessary to study	The development of modern lightning protection systems should be based on reliable data on lightning activity and the characteristics of the various components of lightning discharges. It is important to have such data for certain types of objects and regions. They can be obtained by automated registration of lightning on individual buildings and using remote systems.
Why you can learn (learning outcomes)	Orient in methods and means of registration of lightning characteristics. Get acquainted with the models of lightning discharge, which are used to develop their registration systems and protection systems. Analyze data from lightning detection systems and use them to develop lightning protection systems for various objects.
How to use the acquired knowledge and skills (competencies)	Reasonably develop or choose means and systems for registration of lightning characteristics. Analyze data from lightning detection systems and use them to develop lightning protection systems for various objects (direct and indirect actions).
Information support	Syllabus, teaching materials (manuals, presentations for lectures, etc.), standards.
Type of classes	Lectures, practical classes.
Type of semester control	Test

Discipline	Application of information technologies in active systems of distribution of electric energy
Higher education degree	Third (educational and scientific)
Year	2
Number of credits	4 ECTS credits
Language	Ukrainian, English
Department	Power supply
Requirements for the beginning of the study	The discipline is based on the knowledge received at studying of such disciplines as: "Information technologies in power supply systems", "System analysis of difficult systems of providing consumers with electric energy", "Electric networks and systems", "Systems of distribution of electric energy and their management", "Intelligent technologies in power supply systems "," Relay protection systems and automation of power supply control ".
What will be studied	General characteristics, principles of work and prospects of involvement of modern information systems in construction and management of functioning of active systems of distribution of electric energy. Features of the use of information systems for modeling the modes of distribution networks in the conditions of wide involvement of dispersed means of energy generation and accumulation.
Why it is interesting / necessary to study	The study of the discipline will allow: to acquire knowledge about the general principles of construction, operation and features of the use of information systems in distribution networks; gain the ability to justify the location of these tools and master the methods of rational use of information to ensure optimal modes of distribution and consumption of electricity.
Why you can learn (learning outcomes)	Perform simulation modeling of distribution networks with integrated in them various dispersed means of energy generation and storage and equipped with modern information and measurement systems, use modern methods of optimization and decision making in centralized and decentralized control of active power distribution systems based on the received.
How to use the acquired knowledge and skills (competencies)	The acquired knowledge will allow to carry out complex researches connected with optimum placement and use of modern information-measuring and control complexes in the conditions of wide introduction of renewable energy sources in distribution networks, to use the received data to manage modes of power distribution systems for efficiency and quality of power supply; set and solve research tasks in these areas; to ensure the quality of scientific research and compliance with the rules of academic integrity in the implementation of scientific and pedagogical activities.
Information support	Syllabus, teaching materials (manuals, presentations for lectures, etc.), standards.
Type of classes	Lectures, practical classes.
Type of semester control	Test