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

Department of Automation of Electromechanical Systems and Electric Drive FEA

COURSE PROJECT ON ELECTROMECHANICAL SYSTEMS OF ELECTRIC VEHICLES

Work program of the discipline (Syllabus)

Details of the discipline	
Level of higher education	***Second (master's)***
Branch of knowledge	*14 "Electrical Engineering"*
Specialty	*141 "Electric power, electrical engineering and electromechanics"*
Educational program	*Electromechanical automation systems, electric drive and electric mobility*
Discipline status	*Required*
Form of study	*Eye (day)*
Year of preparation, semester	*First course, the spring semester*
The scope of discipline	*45 hours / 1.5 ECTS credits*
Semester control / control measures	*Offset / MCR*
Timetable	*http://rozklad.kpi.ua*
Language of instruction	*Ukrainian / English*
Information about the course leader / teachers	Lecturer: *Dr. Serhii Kovbasa, 0674351881*
Course placement	

Curriculum

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

Syllabus of the discipline "Course project withelectromechanical systems of electric vehicles»Compiled in accordance with the educational program" Power Engineering, Electrical Engineering and Electromechanics "training of masters majoring in 141 - Power Engineering, Electrical Engineering and Electromechanics.

The purpose of the discipline*there is a formation of students' following abilities: the ability to search for information from various sources; processing and analysisability to apply knowledge in practical situations; ability to learn and master modern knowledge; ability to identify and assess risks.*

The subject of the discipline *- electromechanical systems of electric vehicles, which include new electromechanical converters, power electronics, control and signal processing methods, as well as issues of modern research in the field of electromechanical systems of electric vehicles.*

Program learning outcomes:

Competencies: (FC2) ability to develop and implement measures to improve the reliability, efficiency and safety in the design and operation of equipment and facilities of electricity, electrical engineering and electromechanics; (FC3) the ability to analyze technical and economic indicators and examination of design decisions in the field of power engineering, electrical engineering and electromechanics; (FC8) the ability to demonstrate awareness and ability to use regulations, norms,

rules and standards in power engineering, electrical engineering and electromechanics; (FC9) the ability to use software for computer modeling, computer-aided design, automated production and automated development or design of elements of electrical, electrical and electromechanical systems;

Skills:(PH01) to reproduce processes in electric power, electrotechnical and electromechanical systems at their computer modeling; (PH02) to outline the plan of measures for increase of reliability, safety of operation and prolongation of a resource of the electric power, electrotechnical and electromechanical equipment and the corresponding complexes and systems; (PH04) to reconstruct existing electrical networks, stations and substations, electrical and electromechanical complexes and systems in order to increase their reliability, efficiency operation and life extension; (PH06) to search for sources of resource support for additional training, research and innovation; (PH11) to communicate freely orally and in writing in state and foreign languages on modern scientific and technical problems of electric power, electrical engineering and electromechanics; (PH14) to master new versions or new software designed for computer modeling of objects and processes in electrical, electrical and electromechanical systems; (PH15) to synthesize algorithms of robust and adaptive, vector control, tracking and program control of movement.

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

To successfully master the discipline, the student must have a "Practical course of foreign language business communication", as much of the latest technology in electromechanical systems of electric vehicles is described in the scientific literature in English. Competences, knowledge and skills acquired in the process of studying the credit module are necessary for further internship for a master's thesis.

3. The content of the discipline

Discipline "Course project withelectromechanical systems of electric vehicles»Consists of the following stages:

1. *Getting a topic and assignments for a course project.*
2. *Formation of initial data for calculation.*
3. *Calculation and selection of the main power elements of the electromechanical system, study of the efficiency of recuperation.*
4. *Development of a power semiconductor converter.*
5. *Development of the scheme of the electric principal control controller.*
6. *Development of the scheme of connections of the electric equipment.*
7. *Elaboration of the economic part.*
8. *Registration of the course project and its submission for check.*
9. *Course project defense.*

4. Training materials and resources

1. Zagirnyak MV, Klepikov VB, Kovbasa SM, Mikhalsky VM, Peresada SM, Sadovoy OV, Shapoval IA Energy efficient electromechanical systems for a wide range of technological purposes. Kyiv: NAS of Ukraine, 2018. 310 p.

2. Methods of robust adaptive control of electromechanical systems with increased dynamic and energy performance: GDR report. NTUU "KPI". № DP 0115U000381. Kyiv, 2017. 506 p.

3. Development of energy-efficient electromechanical electric bus system based on adaptive vector-controlled asynchronous electric drive with battery-supercapacitor power supply: report on GDR / NTUU "KPI". № DP 0117U004284. Kyiv, 2018. Volume 1. 472 p.

4. M. Ehsani, Y. Gao, S. Longo, KM Ebrahimi Modern Electric, Hybrid Electric, and Fuel Cell Vehicles. Third edition. - CRC Press, 2018, –573p.

5. Kovbasa SM Development of the theory of gearless vector control of electromechanical systems with asynchronous motors .: Dis. Dr. tech. Science: 05.09.03. Kiev. 2020

6. J. Larminie, J. Lowry Electric vehicle technology explained. –WILEY. 2012. –328p.

7. A. Emadi Handbook of Automotive Power Electronics and Motor Drives. –CRC Press. 2005. –668p.

8. Theory of electric drive / Ed. M.G. Popovich.- K .: Higher school, 1993.-494 p.

Educational content

5. Methods of mastering the discipline (educational component)

Each student is given a technical task for the development of an electromechanical system of an electric vehicle (ETZ) in the form of an existing prototype of a car, truck, motorcycle or bus.

In the course project implementation process, students must:

1. *Find information about the performance of the prototype for ETZ, its kinematic scheme, which is the basic information for further calculations.*
2. *To form the diagram of movement of the vehicle in the form of dependence of speed of ETZ on time. The diagram can be generated arbitrarily or recorded in real traffic using a GPS tracker.*
3. *Calculate the forces acting on the vehicle during its movement, build a load diagram of the engine, calculate the power and select the drive engine.*
4. *Calculate the required capacity of the battery or supercapacitor, select its elements, calculate its weight and volume.*
5. *Develop an electrical circuit diagram of the power part of a power semiconductor converter.*
6. *Develop an electrical circuit diagram of the control controller.*
7. *Develop a connection diagram of the electromechanical system ETZ.*
8. *Determine the cost of all elements of the system, calculate and compare the level of operating costs of the prototype (with an internal combustion engine) and ETZ.*

6. Independent work of student

№з / п	*Type of independent work*	*Number hours of CPC*
1	*Getting a topic and assignments for a course project.*	*1*
2	*Formation of initial data for calculation.*	*2*
3	*Calculation and selection of the main power elements of the electromechanical system, study of the efficiency of recuperation.*	*8*
4	*Development of a power semiconductor converter.*	*8*
5	*Development of the scheme of the electric principal control controller.*	*8*
6	*Development of the scheme of connections of the electric equipment.*	*4*
7	*Elaboration of the economic part.*	*4*
8	*Registration of the course project and its submission for check.*	*8*
9	*Course project defense.*	*2*

Policy and control

7. Course policy (educational component)

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

- *Academic Integrity Policy: Code of Honor of the National Technical University of Ukraine "Kyiv Polytechnic Institute" https://kpi.ua/files/honorcode.pdf establishes general moral principles, rules of ethical conduct of individuals and provides a policy of academic integrity for people who work and study at the university, which they should be guided in their activities, including the study and preparation of control measures in the discipline "Course project on electromechanical systems of electric vehicles";*
- *when using digital means of communication with the teacher (mobile communication, e-mail, correspondence on forums and social networks, etc.) it is necessary to adhere to generally accepted ethical norms, in particular to be polite and limit communication during the teacher's working hours;*
- *students are required to attend consultations on the subject "Course project on electromechanical systems of electric vehicles";*
- *students are required to regularly review messages in the Google classroom and / or shared telegram channel, as well as promptly respond to them;*
- *in the case of distance learning, students must upload the course project sections to the Google classroom in time to test.*

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

The rating assessment of the course project has two components. The first (starting) characterizes the student's work on course design and its result - the quality of the explanatory note and graphic material.

The second component characterizes the quality of defense of the student's term paper

The size of the scale of the starting component is 40 points, and the protection component is 60 points.

1. *Starting component:*
   - timeliness of the course work schedule - 14 points (for a timely submitted section there are 2 points, delivery with a delay of up to one week - 1 point, a delay of more than two weeks - 0 points.);
   - the quality of the explanatory note - 12 points;
   - quality of graphic material and compliance with standards - 14 points.
2. *Component of course work defense:*

five questions are asked in defense of the student; correct and complete answer to each question is estimated at 12 points.

The head of the course project has the right to note the originality of technical solutions, activity and timeliness of the course project by accruing additional bonus points of up to 10 points.

Table of correspondence of rating points to grades on the university scale:

Scores	*Rating*
95-100	*Perfectly*
85-94	*Very good*
75-84	*Fine*
65-74	*Satisfactorily*

60-64	*Enough*
Less than 60	*Unsatisfactorily*
Less than 30	*Not allowed*

9. Additional information on the discipline (educational component)

Certificates of distance or online courses on the subject can be credited subject to compliance with the requirements set out in Order № 7-177 of 01.10.2020 On approval of the provisions on recognition in the KPI. Igor Sikorsky learning outcomes acquired in non-formal / informal education

Work program of the discipline (syllabus):

FoldedAssociate Professor of Automation of Electromechanical Systems and Electric Drive FEA, Dr. Serhii Kovbasa

ApprovedDepartment of Automation of Electromechanical Systems and Electric Drive FEA (protocol № 12 dated 30.06.2021)

Agreed Methodical commission of the faculty[1] (Protocol № __ of _____)

[1]Methodical council of the university - for general university disciplines.