Syllabus of the educational component
Program of educational discipline

Design of Mechatronic Systems

Code and name of specialty
141 – Power engineering, electrical engineering and electromechanics

Institute
Educational and Scientific Institute of Energy, Electronics and Electromechanics

Educational program
Electric drive, mechatronics and robotics

Department
Automated electromechanical systems (129)

Educational level
Master's degree

Type of discipline
Selective

Semester
1

Language of teaching
English

Lecturers and course developers

Serhii Pohasii

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Candidate of economic sciences, associate professor of the department of cybersecurity of National Technical University "Kharkiv Polytechnic Institute".

The number of scientific publications: more than 95, including 2 utility model patents, 6 monographs, of which 4 are collective monographs, 4 teaching aids, 4 of which bear the seal of the Ministry of Education and Science of Ukraine, 65 articles in foreign publications and specialized publications of Ukraine, with 11 of them are in the Scopus scientometric database. Leading lecturer in the disciplines: "Analog and digital electronic devices", "Internet of things and services", "Security of cloud technologies", "Fundamentals of construction and protection of modern operating systems", "Modeling of critical infrastructure systems", "Fundamentals of construction and protection of microprocessor systems ", "Security of smart technologies and Internet of things", "Information and communication systems in the field of national security" for undergraduate and graduate students, Section "Information security of cloud services", "Modern methods of protection of socio-cyber-physical systems", "Modeling of mechanisms cyber security" for graduate students.

More about the lecturer on the department's website

general information

Abstract

The discipline is aimed at mastering the basics of construction. The types and characteristics of the construction of robots and mechatronic systems, problems, principles, methods and means of construction are considered. Examples of structural solutions are given

Purpose and objectives of the disciplines

Develop the student's theoretical ideas and practical skills in designing robots and mechatronic systems

Format of classes

Lectures, laboratory work, independent work, consultations. The final control is an exam.

Competences

K01. Ability to abstract thinking, analysis and synthesis.
K02. Ability to use a foreign language for professional, scientific and technical activities and communication.
K03. Ability to search, process and analyze information from various sources. K04.
Ability to use information and communication technologies.

K05. Ability to apply knowledge in practical situations, work independently and in a team. K13. Awareness of the need to constantly expand one's own knowledge of new technologies in electric power, electrical engineering and electromechanics.
K14. Knowledge and understanding of modern technological processes and systems of technological preparation of production, technical characteristics, design features, purpose and rules of operation of electric power, electrotechnical and electromechanical equipment and equipment.
K15. Ability to apply acquired theoretical knowledge, scientific and technical methods and appropriate software to solve scientific and technical problems and conduct scientific research in the field of electric power, electrical engineering and electromechanics.
K16. The ability to apply existing and develop new methods, methodologies, technologies and procedures for solving engineering tasks, including in the design and operation of power engineering, electrical engineering and electromechanics facilities.
K17. The ability to apply analytical methods of analysis, mathematical modeling and perform physical, mathematical and computational experiments to solve engineering problems and
when conducting scientific research.
K18. Ability to apply information and communication technologies and programming skills to solve typical tasks of engineering and scientific activities in electric power, electrical engineering and electromechanics.
K22. The ability to analyze the current state and determine trends in the development of electric drive systems and the theory of automatic control, numerical control systems, mechatronic systems, metal cutting machines, industrial and mobile robots.
K23. The ability to use modern methods of mathematical apparatus in the design of electromechanical and mechatronic systems and microprocessor control systems of electric drives.
K24. Ability to apply the principles of increasing energy efficiency in electric drive systems of industrial enterprises.
K26. The ability to use modern means of computing, communication and communication in carrying out technical calculations of means of automation of enterprises and designing mecha-
ronal systems and modules.
K27. The ability to use modern methods of design and calculation of individual mechatronic systems and modules and methods of mathematical and computer modeling to study the dynamic characteristics of mechatronic and robotic systems.

Learning outcomes

PR03. Master new versions or new software designed for computer modeling of objects and processes in electric power, electrotechnical and electromechanical systems.
PR06. To have the methods of mathematical and physical modeling of objects and processes in electric power, electrotechnical and electromechanical systems.
PR08. Search for sources of resource support for additional training, scientific and innovative activities.
PR10. Adhere to the principles and rules of academic integrity in educational and scientific activities.
PR12. Communicate freely orally and in writing in national and foreign languages on modern scientific and technical problems of electric power, electrical engineering and electromechanics.

PR16. To master new methods of synthesis of electric power, electrotechnical and electromechanical installations and systems with specified indicators.
PR18. To analyze the current state and determine trends in the development of electric drive systems and the theory of automatic control, numerical control systems, mechatronic systems, metal cutting machines, mobile and industrial robots.
PR19. To be able to use modern methods of mathematical apparatus when designing electromechanical systems, microprocessor control systems for electric drives of mechatronic systems.

PR21. To be able to use modern means of computer technology, communication and communication in carrying out technical calculations of enterprise automation and designing mechatronic systems and modules.
PR22. To be able to use modern methods of design and calculation of individual mechatronic systems and modules and methods of mathematical and computer modeling to study the dynamic characteristics of mechatronic and robotic systems.

Scope of the discipline

The total volume of the discipline is 120 hours. (4 ECTS credits): lectures – 32 hours, laboratory work – 32 hours, independent work – 56 hours.

Prerequisites for studying the discipline (prerequisites)

To successfully complete the course, you must have a 1st (bachelor's) level qualification
preparation of the educational program "Electric drive, mechatronics and robotics" or other educational programs of the specialty "Electric power engineering, electrical engineering and electromechanics".

Features of the discipline, methods and technologies of education

Lectures are conducted interactively using multimedia technologies. The project method, the methods of active, problem-based and partially searching presentation are used during the classes. Most theoretical topics are supported by practice in laboratory classes on the use of modern software.

Program of educational discipline

Topics of lectures

Topic 1. Purpose and objectives of the course. Basic concepts of
construction theory Topic 2. Requirements for construction. Design tasks.
Topic 3. Construction process and procedures Topic
4. Types and methods of construction
Topic 5. Design layout Topic 6. Robot
design analysis Topic 7. Finite element
method
Topic 8. Technologies of designing details Topic 9.
Technologies of 3D modeling of the structure
Topic 10. Design elements of robots. Designing mechanical transmissions of robots. Topic
11. Object-oriented description of the design
Topic 12. Designing connections of structural parts Topic 13.
Designing REA of robots
Topic 14. Selection of design CAD
Topic 15. Programming of design procedures by means of CAD Topic 16.
Functional and cost analysis of the design

Topics of practical classes

Practical classes within the discipline are not provided

Topics of laboratory works

Topic 1. Selection and installation of design CAD
Topic 2. Designing electric drives with frequency converters.
Topic 3. Operations with graphic primitives in the design CAD environment Topic 4. Editing graphic documentation in the design CAD environment Topic 5. 3D graphics technologies in solving robot layout tasks
Topic 6. Layout of robots in CAD V-REP
Topic 7. Design layout in CAD AutoCAD

Topic 8. 2D modeling of the shape of structural elements in CAD Topic 9. Using blocks of elements in CAD
Topic 10. Determining the dimensions of the structure
Topic 11. Kinematic analysis of robot design characteristics Topic 12. Calculation of forces acting on robot parts
Topic 13. Modeling of connections of elements of robot mechanisms
Topic 14. Calculation of deformations of the supporting structure
Topic 15. Programming design operations Topic 16. Programming design algorithms

Independent work

The course involves the implementation of an individual calculation task on the topic: "Conceptual design of a robot and creation of design documentation." Based on the results of independent work, a report on its implementation is drawn up.

Literature and educational materials

1. Shepherd I.M. Drive design. - Khmelnytskyi: KhNU, 2013.
2. Pelevin L.E. Synthesis of robotic systems in mechanical engineering.-K.: LLC NVP Interservice, 2016 3 Bazhenov V.A. and other. Computer technologies for calculating spatial structures at static and dynamic loads.-K.: Karavela, 2018.
4 Kostyuk V.S. and other. Applied mechanics and design basics. -K.: Condor, 2018.
5. Vanin V.V. and other. Computer engineering graphics in the AutoCAD environment: training manual. - K., 2013.
3. Zinko R.V. 3D modeling systems: a study guide. - Lviv, 2017.

Evaluation system

Criteria for evaluating student performance and distribution of points

100% of the final grade consists of the results of the assessment in the form of an exam (10%) and the current assessment (90%).

Exam: written assignment and oral report. Current: implementation individual settlement task, semestercontrol work and laboratory practice (30% each).

Rating scale

Total points	National assessment	ECTS
90–100	Perfectly	A
82–89	Fine	B
75–81	Fine	C
64–74	Satisfactorily	D
60–63	Satisfactorily	E
35–59	Unsatisfactorily (further study required)	FX
1–34	Unsatisfactorily (re-study required)	F

Norms of academic ethics and policy of the course

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": show discipline, education, benevolence, honesty, responsibility.

Conflict situations should be openly discussed in study groups with the teacher, and if it is impossible to resolve the conflict, it should be brought to the attention of the employees of the institute's directorate. Regulatory and legal support for the implementation of the principles of academic integrity of NTU "KhPI" is posted on the website:http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Coordination

Syllabus approved	21/09/2023	Head of Department Bohdan VOROBYOV
	2109/2023	Guarantor of EP Vera SHAMARDINA