National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"

Department of Automation of Electrotechnical and Mechatronic Complexes

Fundamentals of Scientific Research

Working program of the academic discipline (Syllabus)

Details of the academic discipline	
Level of higher education	*Second (master's degree)*
Branch of knowledge	*14 Electrical engineering*
Specialty	*141 Power engineering, electrical engineering and electromechanics*
Educational program	*Engineering of intelligent electrotechnical and mechatronic complexes*
Статус дисципліни	*Normative*
Форма навчання	*daytime*
Year of preparation, semester	*1 year, autumn semester*
Scope of the discipline	*2 credits ESTC / 60 hours (18 hours of lectures, 18 hours of practice, 24 hours of individual student work)*
Semester control/ control activities	*Test*
Class schedule	*roz.kpi.ua*
Teaching language	*English*
Information about head of the course / teachers	*Lecturer and practical classes: Ph.D., Assoc. Prof. Leonid Kulakovskyi e-mail: kulakovskiyl@ukr.net; ph. +38-097-453-65-46 (08:00 – 16:00)*
Placement of the course	*https://classroom.google.com/c/MTQ2MzQzMDkxNzUy?cjc=xgpmry4*

Program of educational discipline

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

The purpose of the academic discipline is to master the theoretical and practical aspects of conducting scientific work. Special attention is paid to ***methodological and methodical issues of preparation of technical, operational, ecological and economic conditions for the reliable functioning of the newly created objects and systems.*** The main task of the educational component is to teach students to use typical methods of scientific research to plan an experiment, process the received data, and evaluate the effectiveness of research works.

Students will receive the following **competencies**: (K11) Ability to apply existing and develop new methods, techniques, technologies and procedures for solving engineering tasks of electric power, electrical engineering and electromechanics; (K12) Ability to develop and implement measures to increase reliability, efficiency and safety in the design and operation of equipment and objects of the power industry, electrical engineering and electromechanics; (K13) Ability to perform analysis of technical and economic indicators and examination of design and construction solutions in the field of electric power, electrical engineering and electromechanics; (K15) Ability to understand and take into account social, ecological, ethical, economic and commercial considerations affecting the implementation of technical solutions in electric power, electrical engineering and electromechanics; (K16) Ability to manage projects and evaluate their results; (K18) Ability to demonstrate awareness and ability to use normative legal acts, norms, rules and standards in electric power, electrical engineering and electromechanics; (K20) Ability to demonstrate awareness of intellectual property and contract issues in electricity, electrical engineering and electromechanics and following **program learning outcomes**: (PR06) Search for sources of resource support for additional training, scientific and innovative activitiesж (PR07) Plan and implement scientific research and innovation projects in the field of electric power, electrical engineering and electromechanicsж

(PR08) Ability to take into account legal and economic aspects of scientific research and innovative activitiesж (PR10) To justify the choice of direction and methodology of scientific research taking into account modern problems in the field of electric power, electrical engineering and electromechanics as a result of studying the discipline "Fundamentals of Scientific Research".

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

In order to successfully master the discipline, the student must have basic knowledge of mandatory components, including "Intellectual property and patent science", "Fundamentals of engineering and technologies of sustainable development". The educational component "Fundamentals of scientific research" is basic for writing and preparing a master's thesis.

3. Content of the academic discipline

The educational discipline consists of 3 sections:

Chapter 1. Basics of scientific research.

Topic 1.1 Algorithms of the research process.

Topic 1.2. Analysis of well-known studies on the topic of the master's thesis.

Topic 1.3. Designation of the universal state classifier of the DCP 016:2010.

Chapter 2. Normative documents regarding the implementation of scientific research.

Topic 2.1. Preparation for carrying out scientific research work (SRW). Requirements for the report from the SRW.

Topic 2.2. Responsibilities of the executor of the SRW. Development, presentation and registration of TK.

Chapter 3. Basic definitions and tasks of research works.

Topic 3.1. DSTU 3321:2003 "Design documentation system". Terms.

Topic 3.2. Development of the technical task (TT) for the implementation of research and development works (RDW).

Topic 3.3. Preparation of a literature review and design rules according to international standards.

4. Educational materials and resources

Primary literature:

1. Kelly, Marcy. The Fundamentals of Scientific Research. 1st ed. Wiley, 2015. Web. 14 Oct. 2022.

2. Fundamentals of Scientific Writing: educational method manual / A. O. Borisova [etc.]. - Kh.: KhDUHT, 2018. - 128 p.

3. V. Migal and Shch. Arhun and A. Hnatov and M. Shuliak and S. Ponikarovska Methodology of Presenting the Results of Scientific Research, EAI Endorsed Transactions on Energy Web, Vol. 8, Issue 36, 2021, p. 12-19

4. Master Thesis. Organization, Requirements to Structure, Contents and performance [Electronic resource]: the manual book for the students by specialty 171 “Electronics”/ Igor Sikorsky KPI; compilers: Yu.S. Yamnenko, L.M. Batrak, I.V. Melnik. – Electronic Text Data (1 file: 429 kb). – Kyiv: Igor Sikorsky KPI, 2021. – 50 p.

Secondary literature:

1. Migal V, Arhun S, Hnatov A, Zharko Yu. (2020). Problem statement and presentation of results of scientific research in dissertation works in technical sciences. Vehicle and Electronics. Innovative Technologies, (18), 6.https://doi.org/10.30977/VEIT.2226-9266.2020.18.0.6

2. Disman D, Ali M, Barliana MS (2017) The use of quantitative research method and statistical data analysis in dissertation: an evaluation study. International Journal of Education 10:46–52

3. Abiad, Zouhour and El-Chaarani, Hani HOW TO WRITE YOUR MASTER THESIS: THE EASY HANDBOOK, Journal of Contemporary Research in Business Adminsitration and Econmic Sciences, New Edition, 2021, 45 p.

4. Biggam J (2015) Succeeding with your master's dissertation: a step-by-step handbook. McGraw-Hill Education (UK)

5. Okoduwa, S.I.R. (2016). The Fundamentals of Scientific Research Paper. 10.13140/RG.2.2.28131.76323.

6. Pitchai Balakumar and Gowraganahalli Jagadeesh The basic concepts of scientific research and scientific communication, J Pharmacol Pharmacother. 2012 Apr-Jun; 3(2): 178–182. doi: 10.4103/0976-500X.95522

Literature, the bibliography of which is provided with a link, can be found on the Internet. Literature, the bibliography of which does not contain references, can be found in the library of KPI named after Igor Sikorsky. All other literary sources are optional, it is recommended to familiarize yourself with them.

Educational content

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

Active learning strategies are applied, which are determined by the following methods and technologies: problem-based learning methods (research method); person-oriented technologies based on such forms and methods of learning as visualization and information and communication technologies, in particular electronic presentations for lectures. Teaching is conducted in the form of lectures and practical classes. The problem-search method is used.

№ з/п	The name of lecture's topic and a list of main questions
1	***INTRODUCTION***
	Lecture 1. Algorithms of the research process. Problem selection and general requirements for the research topic. Specification of the research problem. Methods of planning scientific research. **Recommended literature:** [1, 2]
2	**Lecture 2.** Analysis of well-known studies on the topic of the master's thesis. Review of literary sources on the research topic. Global network Internet. **Recommended literature:** [1, 3]
3	**Lecture 3.** Appointment of the universal state classifier of the DCP 016:2010. **Recommended literature:** [2, 4]
4	**Lecture 4**. Preparation for carrying out research work. Requirements for the report from the SRW. Procedure for teaching a scientific research report. Structural elements of report "COVER SHEET", "ABSTRACT", "INTRODUCTION", "Contents of the report (the essence of the report)" and "Conclusions". Structural elements of the introductory part. DSTU 3008:2015 requirements for the report. **Recommended literature:** [2, 4]
5	**Lecture 5**. Responsibilities of the executor of SRW. Development, presentation and registration of TK. Stages of the SRW. Choice of research direction. Theoretical and experimental studies. Generalization and evaluation of research results, compilation of report documentation. Preparation for acceptance of the SRW. Acceptance for the SRW. **Recommended literature:** [1, 2, 3]
6	**Lecture 6.** DSTU 3321:2003 "Design documentation system". Terms. Rules for performing research and development works. Stages of development and stages of implementation of DKR. Technical proposal. Sketch project. **Recommended literature:** [3, 4]
7	**Lecture 7.** DSTU 3321:2003 "Design documentation system". Terms. Technical project. Working design documentation of a test sample (trial batch) of a product intended for serial (mass) or individual production. **Recommended literature:** [3, 4]
8	**Lecture 8.** Development of the technical task (TT) for the implementation of research and development works (RDW). **Recommended literature:** [2, 3]

9	**Lecture 9.** Preparation of a literature review and design rules according to international standards. Referencing literary sources and preparing a literature review. Introduction and conclusions as independent parts of scientific work, and scientific novelty and practical significance as its quintessence. **Recommended literature:** [2, 3]

Practical classes:

The main tasks of the cycle of practical classes are devoted to the formation of competences in the implementation of SWR and DKR for innovative projects on the topic of the master's thesis

№ з/п	The name of practical topic and a list of main questions
1	**Practical class 1.** Justification of the choice: – topic of the master's thesis (MT); – the idea of master's research; – purpose and tasks of MT; – subject and object of research; Selection of research keywords. Determine the UDC of your research, identify international and domestic scientific bases according to the selected keywords. For example, **Elsevier, Research Gates.**
2	**Practical class 2.** Determination of international and domestic scientific bases. Work with scientific literature. Bibliographic bases for the analysis of known studies. 1) https://doaj.org/ 2) http://www.sciencedirect.com/science/search 3) http://search.crossref.org/ 4) http://journals.indexcopernicus.com/ 5) http://www.worldcat.org/
3	**Practical class 3.** World trends in solving the problems. An overview of modern solutions for the given research task. Identify leading scientists engaged in similar tasks.
4	**Practical class 4.** To determine the practical significance of the obtained research results. Establish global trends in solving the problems.
5	**Practical class 5.** Preparation of the list of literature according to DSTU 8302:2015.
6	**Practical class 6.** Presentation the scientific results on the conferences.
9	***Final class. Test***

The total number of hours is 18.

6. Student individual work

The student's individual work involves:
preparation for classroom classes -20 hours.;
preparation for the test - 4 hours;

Policy and control

7. Policy of academic discipline (educational component)

The student must have the Zoom application installed on the device from which he works (in the case of distance learning), and the course "Fundamentals of scientific research" on the "Sikorsky" platform

(the access code to the course is provided at the first lesson according to the schedule) before each lesson, both lecture and practical.

The study of the academic discipline "Fundamentals of scientific research" requires the student of higher education:

- observance of educational and academic ethics;
- compliance with the schedule of the educational process;
- be balanced, attentive in classes;
- systematically study theoretical material;
- compliance with the schedule of protection of practical and laboratory works. The applicant's answer must demonstrate signs of independent performance of the assigned task, absence of signs of repetition and plagiarism.

The student is awarded 10 points for publication article (a publication included in Scopus or Web of Science) or 6 points (a specialized publication of Ukraine and its publication). 5 points for publication of report abstracts at a scientific conference. The total amount of incentive points cannot exceed 10 points.

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

Calendar control:

The student's rating in the discipline consists of the points he receives for:

1) Express control in 4 lecture classes. 7 points x 4= 28 points

2) Completion of 6 practical works 12 points x 6 = 72 points

System of rating points

The rating scale for the discipline is R=7*4+12*6=100 points

Tasks within the framework of practical work are evaluated in 12 points according to the following criteria:

– "excellent" – complete answer (at least 90% of the required information) – 12-11 points;

– "good" – a sufficiently complete answer (at least 75% of the required information), completed in accordance with the requirements for the "skills" level or containing minor inaccuracies – 10-6 points;

– "satisfactory" – an incomplete answer (at least 60% of the required information), completed in accordance with the requirements for the "stereotypical" level and containing some errors – 6-4 points;

– "unsatisfactory" – unsatisfactory answer – 0 points.

Calendar control: conducted twice a semester as a monitoring of the current status of meeting the syllabus requirements. The condition for a positive first and second calendar control is to obtain at least 50% of the maximum possible rating at the time of the corresponding calendar control.

Semester control: test. Conditions for admission to the semester control: all practical work has been completed and credited.

Students who have met all the admission requirements and have a rating of 60 or more points receive a rating corresponding to the rating without additional tests. The sum of the rating points received by the student during the semester is transferred to the final grade according to the table.

If the sum of points is less than 60, the student completes a credit test. In this case, the sum of the points for the practical and for the credit control work is transferred to the final grade according to the table.

A student who received more than 60 points in the semester, but wants to improve his result, can take part in a credit test. In this case, the final result consists of the points obtained on the final test and the points of the practical work.

The credit work is estimated at 66 points. The control task of this paper consists of three theoretical questions.

Each question and task is evaluated in 22 points according to the following criteria:

- "excellent" – a complete answer (at least 90% of the required information), relevant justifications and a personal opinion are provided – 22 - 19 points;
- "good" – a sufficiently complete answer (at least 75% of the required information), which is completed in accordance with the requirements for the "skills" level or contains minor inaccuracies – 18 - 16 points;
- "satisfactory" – an incomplete answer (at least 60% of the required information), completed in accordance with the requirements for the "stereotype" level and containing some errors – 15 - 13 points;
- "unsatisfactory" – unsatisfactory answer – 0 points.

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

RD=Rc+Re	Evaluation ECTS	Traditional assessment
95-100	A	excellent
85-94	B	very good
75-84	C	good
65-74	D	satisfactory
60-64	E	acceptable
Less 60	FX	unsatisfactory
Not submitted practical tasks, or Rc<30	F	not allowed

9. Additional information about the discipline (educational component)

A student of higher education has the opportunity to take an online course(s) on one or more topics provided by the work program for the academic discipline. The student can choose an online course independently or on the recommendation from a lecturer. 1 hour of the course is valued at 0.83 points. The maximum number of hours that can be credited based on the results of non-formal education is 12 hours, accordingly the maximum number of points for such results is 10 points.

Working program of the academic discipline (syllabus):

Compiled by: doctor of technical sciences, **Prof. Viktor Rozen**

Approved by: AEMC department **(protocol No.** №17 dated 05/31/23)

Agreed: Methodical commission of the faculty NN IEE (**protocol No.** 9 dated 06/22/2023)