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

Department of Aircraft and Rocket Engineering

SCIENTIFIC WORK ON THE THEME OF MASTER'S THESIS-2. BASIS OF SCIENTIFIC RESEARCH

Work programme of the academic discipline (Silabus)

Details of the discipline

Level of higher education	*Second (master's)*
Field of knowledge	*13 Mechanical engineering*
Specialty	*134 Aviation and aerospace technologies*
Educational program	*Aviation and aerospace technologies*
Status of the discipline	*Cycle of professional training*
Form of study	*Full-time form of study*
Year of preparation, semester	*1 course, spring semester*
Scope of the discipline	*60 hours*
Semester control/ control measures	*Credit*
Lessons schedule	*http://rozklad.kpi.ua*
Language of teaching	*Ukrainian/English*
Information about the teacher course leader	*Lecturer: Associate Professor P.V. Lukianov,lvptvl@ukr.net* *Practice: Associate Professor Lukyanov P.V., lvptvl@ukr.net*
Placement course	*https://campus.kpi.ua*

Program of educational discipline

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

- This discipline is aimed at providing masters with practical knowledge of the methodology and techniques of scientific research at the stage of completing a master's thesis, forming a technical task, physical and mathematical model describing a mechanical structure. This will allow them to independently set and solve complex problems of aerodynamics, design and manufacture of aircraft.

The aim of the discipline is to develop students' **competencies**:

GC 2. Ability to identify, formulate and solve problems

GC 3. Ability to conduct research at the appropriate level.

GC 6. Ability to adapt and act in a new situation.

GC 8. Determination and perseverance in tasks and responsibilities

PC 1. Awareness of the history, current state, problems and prospects of development of aviation and rocket and space technology.

PC 2. Ability to critically comprehend the problems of aviation and/or rocket and space technology, including on the border with related fields, engineering sciences, physics, chemistry, ecology, economics

PC 5. Ability to create, improve and apply mathematical and numerical methods of modelling properties, phenomena and processes in systems and elements of aviation and rocket and space technology.

PC 7. Ability to perform engineering and management work to prepare the production of aviation and rocket and space technology using the latest technologies.

And also additional **competencies**:

- develop physical and mathematical models of systems and processes;
- to implement physical and mathematical models of systems and processes using the methods of mathematical physics, with the use of modern information technologies;
- prepare scientific and technical publications based on the results of research;
- to organise and conduct scientific research related to the analysis of the properties of air currents in extreme flight conditions, including the use of modern mathematical methods;
- organise and conduct research related to the development and analysis of the properties of advanced composite materials;
- organise and conduct research related to the analysis of the strength of aircraft structures;
- perform research on the design of modern aircraft structures.
- In accordance with the requirements of the educational and professional programme, students must acquire the following learning skills after mastering the discipline:
- **knowledge:**
- methods of constructing physical models of the studied processes;
- methods of implementing physical models in the form of mathematical models, equations, systems of equations describing physical processes;
- basics of mathematical physics;
- rules of execution of agreements on scientific activity;
- rules for the preparation of scientific articles and monographs in domestic and foreign professional journals.

Skills:

Programme learning outcomes:

PLO 1. To know and understand the principles of basic and engineering sciences underlying aviation and/or rocket and space technology.

PLO 4. To use modern methods of solving inventive problems, to protect intellectual property for technical solutions and other results of professional (scientific and technical) activity.

PLO 6. To make effective decisions in the event of non-standard complex tasks in professional (scientific and technical) activities in conditions of uncertainty of requirements, the availability of a range of opinions and limited time.

PLO 7. To demonstrate skills of independent and teamwork, leadership qualities, to organise work under time constraints with an emphasis on professional integrity

PLO 8. To prepare reporting documentation on the results of solving complex professional (scientific and technical) problems, to present the research in the form of scientific reports, publications, conference reports, etc.

PLO 10. Calculate the economic efficiency of the production of elements and systems of aviation rocket and space technology.

PLO 12. To apply the requirements of industry and international regulations in the formulation and solution of scientific and technical problems of design, production, repair, assembly, testing and (or) certification of elements and objects of aviation and rocket and space technology at all stages of its life cycle.
PLO 14. Organise the implementation of complex tasks in professional activities by the team.
PLO 15. Apply modern methods and tools for design and systems of modern aviation and rocket and space technology.
PLO 17. Use in practice modern methods and means of design, production, testing, repair and (or) certification of aviation and rocket and space technology systems.
PLO 19. Develop and teach academic disciplines in higher education.

Additional skills:

- on the basis of the provided technical task to form a physical model of the studied design of the aircraft, helicopter, rocket;
- using methods to determine the solved and formulate unsolved problems on the problem or task under study;
- formulate the purpose of the study and the tasks to be solved to achieve it;
experience:
- performing an analytical review of available sources of information on the problem;
- systematisation of solving tasks on the problem;
- justification of the purpose of research or development;
- formulation of tasks, the solution of which leads to the achievement of the development goal.

2. Prerequisites and post-requisites of the discipline (place in the structural and logical scheme of study for the relevant educational programme)

The study of this discipline requires students to have the skills of using personal computers at the level of an experienced user, as well as the knowledge and skills they acquire when studying the disciplines of the first (bachelor's) level of training in the speciality "134 Aviation and Rocket and Space Engineering".
Successful study of the discipline prepares students for a master's thesis.

3. Content of the discipline

Chapter and topic titles	Number of hours				
	Total	including			
		Lectures	Practice works	-	IWS
Chapter 1. Scientific investigation					
	60	-	18	-	42
Total hours:	60	-	18	-	42

4. Training materials and resources

Literatures:

1.V.S.Herasymchuk. Metody matematychnoi fizyky. Chastyna 2. Matematychni modeli deiakykh poshyrenykh yavyshch.- Kyiv,KPI im.Ihoria Sikorskoho 2022,38p.
2.V.O.Pozdieiev, V.M.Sichko. Matematychne modeliuvannia fizychnykh protsesiv. –

Mykolaiv,MNU,-2021, 134p.
3.V.O.Mishchenko, O.H.Tolstoluzka,I.H.Marchenko. Modeliuvannia fizychnykh protsesiv iz vykorystanniam tekhnolohii CUDA.-Kharkiv, KhNU,-2017,117p.
4.S.S.Pikh, O.M.Popel, A.A.Rovenchak,I.I.Talianskyi. Metody matematychnoi fizyky. Lviv : LNU im. I. Franka, 2011. — 404p.
5. Charles Hirsch. Numerical computation of internal and external flow. Vol.1.Fundamentials of computational fluid dynamics.-Elsevier-2007,696p.
6. Jean-Jacques Chattot. Compuatational Aerodynamics and fluid dynamics.-Springer,-2002,190p.

Online resources:

a. http://kpi.ua.
b. http:\\iat.kpi.ua.
c. http:\\arb.kpi.ua.

Educational content

5. Methods of mastering the discipline (educational component)

Lectures.

The credit module "Scientific work on the topic of master's thesis -2" does not contain lectures.

Practical classes

The main goal of practical classes is an in-depth study of scientific research methods, the formation of concepts about a physical model and its mathematical implementation**.**

№ p/c	Title of the practical classes	Number of hours
1	Determination of the class of partial differential equations on the examples of the basic equations of mechanics, aerodynamics,[1].	2
2	Formulation and solution of the Cauchy problem for the wave equation,[1].	2
3	Formulation of the boundary value problem of potential motion of an incompressible ideal fluid,[2.3].	2
4	Study of the process of free oscillations of a string: Problem formulation and solution,[4,5].	4
5	Methods of designing finite difference algorithms for solving aerodynamic problems,[6].	4
6	Application of physical laws for the construction of conservative difference schemes,[6].	4

Таблиця 2

№ i/c	Title of the independent student's classes	Number of ISW hours
1	Fundamentals of modelling physical and technical processes	24
2	Classification of partial differential equations.	24
3		30
4	Formulation of boundary value problems of aerodynamics, transonic aerodynamics of an aircraft, helicopter.	30
5	Theoretical methods of studying physical problems.	39

Laboratory classes.

The credit module "Scientific work on the theme of master's thesis -2" does not include laboratory work.

Independent work of the student

The student's independent work consists of preparing for classroom classes, reading the relevant literature. The scope and topics of students' independent work are set out in Table 2.

Policy and control

5. Policy of academic discipline (educational component)

Grading policy (missed classes, making up for absences): each grade is assigned in accordance with the criteria developed by teacher and announced to students in advance, as well as motivated individually at the student request; if student does not complete all prescribed classes, he will not be admitted to credit; missed classes must be made up. The form and time of practice are mutually agreed upon by student and teacher.

Academic integrity

The policy and principles of academic integrity are defined in Chapter 3 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorsky Kyiv Polytechnic Institute". More details: https://kpi.ua/code https://kpi.ua/code.

Norms of ethical behavior

Standards of ethical behavior of students and employees are defined in Chapter 2 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute". More details: https://kpi.ua/code.

6. **Types of control and rating system for assessing learning outcomes (RSO)**

At the first lesson, students are introduced to the rating system of assessment of the discipline, which is based on the Regulations on the system of assessment of learning outcomes https://document.kpi.ua/files/2020_1-273.pdf

Current control is carried out at each practical lesson in accordance with the specific objectives of the topic in order to check the degree and quality of learning. At all classes, objective control of theoretical training and mastery of practical skills is applied to check the readiness of the higher education student for the class. In the process of current control, the student's independent work is assessed in terms of completeness of tasks, level of learning,

mastery of practical skills of analytical and research work, etc. The results of the current control are entered into the Igor Sikorsky Kyiv Polytechnic Institute Campus System.

Calendar control: is carried out twice a semester as a monitoring of the current state of fulfilment of the requirements of the silaBUS. To receive a "pass" in the first interim assessment (week 8), a student must have at least 15 points (provided that at the beginning of week 8, according to the calendar control plan, an "ideal" student must receive 24 points). To receive "passed" in the second interim assessment (14th week), a student must have at least week), a student will have at least 28 points (provided that at the beginning of week 14, according to the calendar plan of control measures, an "ideal" student should receive 42 points).

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

1. practical classes;

2. tests.

1. Practical work
Weight score – 5.
The maximum number of points is equal to 6 points x8 = 48 points.
Evaluation criteria:
- full completion of the task - 5;
- implementation, but theoretical knowledge is insufficient - 3...4;
- not prepared - 0.

2. Calculation and graphic work
Weight score – 8.
The maximum number of points is equal to 8 points x1 = 8 points.
Evaluation criteria:
• complete completion of the task - 8;
• implementation, but theoretical knowledge is insufficient — 5 ... 6;
• execution, but no report - 3;
• work was not performed - 0.

3. Modular control work
Weight score – 47.
The maximum number of points is equal to 47 points x 1 = 47 points.
Evaluation criteria:
• complete completion of the task - 47;
• incomplete completion of the task - 25...40;
• work was not performed - 0.

Penalty and incentive points:
• creative approach to work, active participation in discussion of topics, independent search for topics: +1...3 points;
• absence of missing lectures without valid reasons: +1...3 points;
• absence from class without a valid reason: –1...–5 points.
The maximum number of incentive points is 5.
Calculation of the rating scale (R):
Thus, the rating scale for the discipline is:
R = 48 + 8 + 44 = 100 points.
Table of correspondence of rating points to grades on the university scale:

Scores	Rating
100-95	Excellent
94-85	Very good
84-75	Good

74-65 Satisfactory
64-60 Enough
Less than 60 Unsatisfactory
Admission conditions are not met Not allowed
9. Additional information on the discipline (educational component)
If a graduate student is transferred from another university is recalculated only if the curriculum is consistent.
Work program of the discipline (syllabus):
Compiled by Associate Professor of the Department of Aircraft and Rocket Engineering, PhD , Lukianov P.V.
Approved by the Department of Aircraft and Rocket Engineering (Minutes № 10 of 16.06.2023)
Approvedby the Methodological Commission of the IAT (Minutes № 6 of 22 .06.2023)