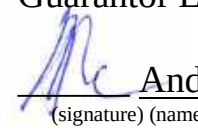
Ministry of Education and Science of Ukraine
National Aerospace University
"Kharkiv Aviation Institute"

Department of Space Technology and Non-Conventional Energy Sources (No. 402)

APPROVE

Guarantor EP



Andriy POGUDIN
(signature) (name and surname)

«_____» _____ 2025

SYLLABUS OF THE MANDATORY COURSE
ACADEMIC DISCIPLINE

Integrated computer technologies for designing unconventional energy installations

(name of academic discipline)

Discipline: 14 "Electrical Engineering"
(code and name of the field of knowledge)

Specialty: 141 "Electrical Power Engineering, Electrical Engineering and Electromechanics"
(code and name of specialty)

Educational program: Non-traditional and renewable energy sources

(name of educational program)

Level of higher education : first (bachelor's degree)

The syllabus is effective from 01.09.2025

Kharkiv – 2025

Developer: Bazima L.O., Ph.D. , associate professor
(surname and initials, position, academic degree and title) (signature)

Syllabus reviewed at department meeting 402
Space technology and non-traditional energy sources
(name of department)

Protocol No. 1 dated " 28 " August 2025

Acting Head of the Department Ph.D. , Associate Professor Yuri Shepetov
(academic degree and academic title) (signature) (initials and surname)

Agreed with the representative of education seekers:

Olexander LISIN
(signature) (first name and last name)

1. General information about the teacher

Full name: Bazima Leon Oleksiyovych
Position: Associate Professor
Scientific degree : candidate of technical sciences
Scientist Title : Associate Professor
The list of disciplines taught: "Integrated computer technologies for designing unconventional power plants", "Fundamentals of the theory and functioning of power plants", "Engineering calculations of power plants using CAD systems", "Mathematical and physical modeling of energy processes", "Modeling and calculation of processes in ARCT".
Areas of scientific research: numerical methods in fluid, gas and plasma mechanics , computational hydrodynamics , modeling of thermal and hydrodynamic processes, modern hydrogen storage systems.
Contact information: +3806 7 - 572 - 8389 leonid . bazyma @khai.edu

2. Description of the academic discipline

Form of education	Daily
Semester	5th
Language of instruction	Ukrainian
Type of discipline	By choice
Course volume: ECTS credits/number of hours	Full-time: 5 ECTS credits / 150 hours (64 classroom hours, of which: lectures – 32, practical – 32; SRH – 86)
Types of educational activities	Lectures, laboratory classes, RR, independent work
Types of control	Current control, module control, semester control – credit
Prerequisites	"Higher Mathematics", "Physics", "Electrical Engineering", "Programming Methods and Computer Calculation Methods"
Co-requisites	"Electrical equipment of power plants"
Post-requisites	"Design of solar and thermal power plants", "Design of NPP"

3. Purpose and objectives of the academic discipline

Purpose of study : to provide knowledge about methods for numerically solving mathematical problems that cannot be solved analytically, or the use of analytical methods leads to a large amount of computational work, as well as methods for finding the maximum or minimum of the objective function in the presence of constraints (search for the optimum).

Task : To consider modern methods of numerical and approximate solution of mathematical problems. Consider methods for optimizing (finding extrema) the objective function.

Competencies acquired:

Integral competence : The ability to solve specialized tasks and solve practical problems during professional activities in the field of electrical power engineering, electrical engineering and electromechanics or in the process of learning, which involves the application of theories and methods of physics and engineering sciences and are characterized by complexity and uncertainty of conditions.

General Competencies (GC)

After completing this program, the student will be able to:

- *to learn and master modern knowledge.*
- *apply knowledge in practical situations.*

- *make decisions and act in accordance with the principle of inadmissibility of corruption and any other manifestations of dishonesty .*

Special competencies:

After completing this program, the student will be able to:

- solve practical problems with the use of computer-aided design and calculation (CAD) systems.

Program learning outcomes:

- Apply applied software to solve practical problems in professional activities.

- Be able to study independently , acquire new knowledge and improve skills in working with modern applied software .

4. Content of the academic discipline

Content module 1. *" Methods for solving systems of linear equations "*

Topic 1. *Introduction to the academic discipline "Integrated Computer Design Technologies"*

Subject of study and tasks of the discipline. Place of the discipline in the curriculum. Basic concepts . Awareness of mathematical models and their construction.

Lectures: " *Basic concepts* ".

Laboratory classes: *none.*

Independent work of the student: *none.*

Topic 2. *Calculation experiment and its errors.*

Procedures and elements of a computational experiment. Discretization error. Rounding error. The influence of rounding errors on the result of arithmetic operations. Inverse analysis of the error of a numerical solution of a problem. The conditionality number of a problem. Basic procedures of a machine experiment.

Lectures: " *Mistakes" computational experiment ”, “ Inverse analysis of the error of the numerical solution of the problem . Conditionality of the problem ”.*

Laboratory classes: *" Solving linear programming (LP) problems using Excel "* .

Independent work of the student: *studying the lecture material, familiarization with various methods for solving linear equations .*

Topic 3. *Methods for solving systems of linear equations .*

Problem formulation. Triangular matrix decomposition of a system of equations. Gauss method for solving systems of linear equations. Computational scheme (forward and reverse steps). Features of the algorithm implementation (Small leading element problem). Degenerate matrix problem. *QR* matrix decomposition and its application for solving systems of linear equations. Gauss algorithm and LU matrix decomposition. Application of *LU* -decomposition. Estimation of the error of solving systems of linear equations by the Gauss method. Matrix inversion and estimation of the norm of the inverse matrix.

Lectures: " *Methods for solving systems of linear equations. Triangular decomposition of the matrix of a system of equations* ", " *Gauss's method for solving systems of linear equations* ", " *Matrix inversion and estimation of the norm of the inverse matrix* ", " *Estimation of the error in solving systems of linear equations by the Gauss method* ".

Laboratory classes: *" Matrix operations ", " Solving a system of nonlinear algebraic equations ", " Finding the complex roots of a system of nonlinear algebraic equations "* .

Independent work of the student: *studying the lecture material, familiarization with various methods of approximating functions .*

Content module 2. *" Function approximation methods "*

Topic 4. *Methods of approximating functions* .

Formulation of the problem of approximation of functions. Interpolation. Approximation . Methods of constructing an interpolation polynomial. Method of undetermined coefficients. Lagrange's method. Interpolation error. Optimal choice of interpolation nodes. Chebyshev's theorem . Stability of an interpolation polynomial to errors in the function specification. Convergence of the interpolation process. Interpolation on grids with multiple nodes. Hermite polynomial . Cubic spline interpolation. Construction of cubic spline . Approximation of functions by algebraic polynomials.

Lectures: " *Methods of approximating functions. Interpolation. Approximation* ", " *Polynomial interpolation* ", " *Optimal choice of interpolation nodes* ", " *Convergence of the interpolation process* ", " *Cubic spline interpolation* ", " *Solution of ordinary differential equations* ", " *Solution of partial differential equations* ".

Laboratory classes: *" Formation of objective functions and search for optimal solutions to engineering problems ", " Solving ordinary differential equations " , "* Solving partial differential equations *"*

Independent work of the student: *studying the lecture material, completing an individual practical assignment and preparing for its defense, familiarization with the implementation of the finite element method in the FlexPDE software product* .

5. Individual tasks

RR

"Building a numerical integration algorithm using Euler's method in Visual Basic (Exel)" or "Solving the problem of magnetostatics by the finite element method in the FlexPDE software product "

6. Teaching methods

Conducting classroom lectures, practical classes , individual consultations (if necessary), independent work of students based on materials published by the department (methodological manuals) .

7. Control methods

Conducting current control in the form of completing laboratory work, final control in the form of a test.

8. Distribution of points received by students

Ongoing testing and independent work					Sum	Final test (test/exam) in case of rejection of the current test scores and if there is admission to the test/exam
Content module 1			Content module 2	Individual task		
T1	T2	T3	T 4			
10	20	20	30	20	100	100

T1 ... T4 – topics of content modules .

Grading scale: national and ECTS

Total points for all types of learning activities	Rating ECTS	National scale assessment	
		for exam, course project (work), practice	for credit
90-100	**AND**	perfectly	enrolled
83-89	**IN**	good	
75-82	**WITH**		
68-74	**D**	satisfactorily	
60-67	**THERE ARE**		
01-59	**FX**	unsatisfactory with the possibility of reassembly	not accepted with the possibility of retaking

9. Course Policy

Attendance at classes. Regulation of absences. The interactive nature of the course requires mandatory attendance at practical classes. Students who, under certain circumstances, cannot attend practical classes regularly must agree with the teacher during the week on a schedule for individual work-through of missed classes. Individual missed classes must be worked out at the nearest consultation within a week after they were missed. Work-through of classes is carried out orally in the form of an interview on questions specified in the class plan. In some cases, written work-through of missed classes is allowed by completing an individual written assignment.

Compliance with the requirements of academic integrity by education seekers during the study of the academic discipline. During the study of the academic discipline, education seekers must adhere to generally accepted moral and ethical norms and rules of conduct, the requirements of academic integrity stipulated by the Regulations on Academic Integrity of the National Aerospace University "Kharkiv Aviation Institute" (https://khai.edu/assets/files/polozhennya/polozhennya-pro-akademichnu-dobrochesnist.pdf). It is expected that the works of education seekers will be their original research or reasoning. The absence of references to the sources used, fabrication of sources, plagiarism, interference in the work of other education seekers are, but are not limited to, examples of possible academic dishonesty . Identification of signs of academic dishonesty in the written work of an education

seeker is grounds for its non-registration by the teacher, regardless of the extent of plagiarism or deception.

Conflict resolution. The order and procedures for resolving conflicts related to corrupt actions, conflicts of interest, various forms of discrimination, sexual harassment, interpersonal relationships and other situations that may arise during training, as well as the rules of ethical behavior are regulated by the Code of Ethical Behavior at the National Aerospace University "Kharkiv Aviation Institute" (https://khai.edu/ua/university/normativna-baza/ustanovchi-dokumenti/kodeks-etichnoi-povedinki/).

10. Methodological support

1. Baz i ma L. O. Computer modeling energy complexes taking into account unconventional sources energy . . Teach Pos and b. to Laboratory . Practicum. – Kharkiv : National Aerospace University “ Kharkiv . Aviation Institute ” , 2006 , 57 p . http://library.khai.edu/library/fulltexts/m2006/Kompijuternoe modelirovanie energetic complexes yes basics non-traditional energy sources.pdf
2. Baz i ma L. O. , Masht i l' ov M. O. Computer modeling processes in electroreactive engines . Learn Pos and b. to Lab . Practicum. – Kharkiv : National Aerospace University “ Kharkiv . Aviation Institute ”, 2003 , pp. 1-45 .
3. https://mentor.khai.edu/course/view.php?id=1428

11. Recommended reading

Basic

1. M.D. Geraimchuk , Y.F. Lazarev , T.O. Tolochko Modeling of systems in the MATLAB-SIMULINK environment : Computer workshop. – K.:, 2006. – 175p.
2. E. Ian Baring-Gould, Hybrid2. The Hybrid System Simulation Model. Version 1.1, User Guide. NREL/TP-440-21272, 1998 , pp. 1-63 .
3. E. Ian Baring-Gould, Hybrid2. The Hybrid System Simulation Model. Version 1.1, User Guide. NREL/TP-440-21272, 1998 , pp. 1-63 .
4. Wind Energy Project Analysis. Minister of Natural Resources Canada 2001 - 2002, pp. 1-28.
5. Photovoltaic Project Analysis. Minister of Natural Resources Canada 2001 - 2004, pp. 1-48.
6. SolidWorks Corporation . The main ones elements SolidWorks 2011. Training . – SolidWorks Corporation , 2011.

Auxiliary

7. D. Knut - Art Programming Volume 2 (3rd Edition) - 2001 (Part 1) https://studizba.com/show/1119452-1-d-knut-iskusstvo-programmirovaniya-tom.html

12. Information resources

1. Powerful Software for Partial Differential Equations FlexPDE - Multiphysics Software for Partial Differential Equations (pdesolutions.com)
2. SOLIDWORKS Web Help . https://help.solidworks.com/
3 . RETScreen Clean Energy Management Software. https://www.nrcan.gc.ca/maps-tools-and-publications/tools/modelling-tools/retscreen/7465
4 . Visual Studio. https://docs.microsoft.com/ru-ru/visualstudio/get-started/visual-studio-ide?view=vs-2022