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

Machines and devices of chemical and oil refining industries

The main ones algorithms for calculation of engineering tasks

Working program of the academic discipline (Syllabus)

Details of the academic discipline	
Level of higher education	***First (undergraduate)***
Branch of knowledge	*13 Mechanical engineering*
Specialty	*133 Industrial engineering*
Educational program	*Computer-integrated technologies of chemical engineering equipment design*
Discipline status	*Selective*
Form of education	*daytime*
Year of training, semester	*3rd year, autumn semester*
Scope of the discipline	*4 credits*
Semester control/ control measures	*Final score, MKR*
Lessons schedule	*http://rozklad.kpi.ua/Schedules/ScheduleGroupSelection.aspx*
Language of teaching	*Ukrainian*
Information about head of the course / teachers	*Lecturer/Practical:senior lecturer of the Department of the National Academy of Sciences of the Russian Academy of Sciences, candidate of technical sciences, R.V. Butterfly net, < astet26081977@gmail.com >*
Placement of the course	https://ci.kpi.ua/uk/syllabuses-bac-disciplines/#place

Program of educational discipline

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

The purpose of the educational discipline.

The purpose of the educational discipline is to form students' competence:

- *Ability to generate new ideas (creativity).*
- *Ability to think systematically.*
- *Ability to achieve set goals.*
- *Abilityapply professional knowledge to conceptualize engineering solutions;*
- *Abilityprepare raw data for the selection and justification of scientific, technical and organizational decisions;*
- *Abilityuse knowledge to analyze engineering products, processes and methods; the ability to choose and apply appropriate analytical methods and mathematical modeling methods;*
- *Abilityprovide modeling of technical objects and technological processes using standard packages and means of automation of engineering calculations, conduct experiments according to specified methods with processing and analysis of results;*

1.2. The main tasks of the academic discipline.

After mastering the academic discipline, students must demonstrate the following learning outcomes:

– knowledge of system and associative methods of finding technical solutions, algorithms for solving inventive and engineering problems;

- *knowledge of basic methods of system analysis;*
- *knowledge and understanding of general principles of operation and architecture of computer systems, mastery of system and application software.*

– *knowledge of mathematical methods in the design of hydromechanical and heat-mass exchange equipment of chemical, oil refining, biotechnological and refrigeration industries;*
– *knowledge of numerical methods, software products and PC capabilities, to determine (calculate) the assessment of the strength and durability of structural elements of lifting and transport machines and rotary conveyor lines;*
– *modern packages of application programs*

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

A list of disciplines that a student needs to master (requirements for the level of training) for successful mastery of the discipline:

- *Mathematics - 1. Analytical geometry. Differential and integral calculus.*
- *Mathematics - 2. Functions of many variables. Rows Probability theory.*
- *Engineering and computer graphics - 1. Engineering graphics.*
- *Engineering and computer graphics - 2. Computer graphics.*

2. Content of the academic discipline

Chapter 1.Usingnumerical methods.

Topic 1.1 Numerical solution of equations.

Introduction. The purpose and tasks of the course are given. The main principles of using numerical methods for solving equations are considered. Basic numerical methods of solution are given. A solution using programming environments is considered.

Chapter 2. Combined problems.

Topic 2.1 Basic principles of working with one-dimensional arrays.

Work with records, cartels and the specifics of algorithms for this work are considered.

Topic 2.2 Basic principles of working with two-dimensional arrays.

The work with multi-level records, cartels and the specifics of the algorithms of this work are considered.

Chapter 3. Numerical integration.

Topic 3.1 Calculation of definite integrals.

The basic principles of using numerical integration are given.A solution using programming environments is considered.

3. Educational materials and resources

3.1 Basic

1. *Synopsis of lectures.*
2. *In Voronin L.G. , Kalendyuk V.G., Mykulonok I.O. , Ruzhynskaya L.I. Methodical instructions for the use of computer technology in the educational process. Kyiv. KPI 1988-60s.*
3. *Dobronohova S.I. , Lukach Yu.E. , Ruzhynskaya L.I. Calculation of devices for heat treatment of thermoplastic products. Kyiv, KPI, 1984.-86p.*
4. *Lukach Y.E., Ruzhinskaya L.Y., Voronin L.G. Automated design of roll machines for polymer processing. Kyiv, Technics, 1988.-208p.*

Educational content

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

Lecture classes

Lectures are aimed at:

- *provision of modern, comprehensive in-depth knowledge of the discipline, the level of which is determined by the target attitude to each specific topic;*
- *provision of critical creative work together with the teacher in the process of work;*
- *education of students' professional qualities and development of their independent creative thinking;*
- *awareness of the methods of processing information resources and determining the main directions for solving specific scientific and technical problems;*
- *teaching research materials in a clear and high-quality language in compliance with structural and logical connections, clarification of all given terms and concepts available for perception by the audience.*

No. z/p	*The name of the topic of the lecture and a list of the main questions (a list of didactic tools, references to the literature and tasks on the SRS)*	
	Chapter 1. Use of numerical methods.	
	Topic 1.1 Numerical solution of equations.	
1	*The main methods of numerical solution of transcendental equations are considered. Method of halving. The Horner-Ruffini method. Newton's method, chord method.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Calculation of error in iterative calculations	
	literature[1, 2, 3, 4]	
2	*Gauss method for calculating systems of linear equations.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Iterative method of Gauss	
	literature[1, 2, 3, 4]	
3	*Newton's method for calculating systems of nonlinear equations.*	*2*
	literature[1, 2, 3, 4]	
	Tasks on SRS: Other methods of calculating systems of nonlinear equations.	
	literature[1, 2, 3, 4]	
	Chapter 2. Combined problems.	
	Topic 2.1 Basic principles of working with one-dimensional arrays.	
4	*Creating a one-dimensional array. Its input-output methods. Finding the minimum and maximum elements in a one-dimensional array. Sorting a one-dimensional array.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Converting a string to an array.	
	literature[1, 2, 3, 4]	
	Topic 2.2 Basic principles of working with two-dimensional arrays.	
5	*Creating a two-dimensional array. Its input-output methods. Finding the minimum and maximum elements in a two-dimensional array. Sorting a two-dimensional array.*	*2*

	literature[1, 2, 3, 4]	
	Task on SRS: Converting a string to an array.	
	literature[1, 2, 3, 4]	
	Chapter 3. Numerical integration.	
	***Topic 3.1 Calculation of definite integrals**.*	
6	*Introduction to numerical integration. The geometric meaning of the definite integral. Application of numerical methods.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Repeat tabular integrals for the purpose of self-checking	
	literature[1, 2, 3, 4]	
7	*Calculation of definite integrals using the methods of left-sided, right-sided, central rectangles and the method of trapezoids.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Error when calculating by the above methods.	
	literature[1, 2, 3, 4]	*2*
8	*Calculation of definite integrals by the Simpson method*	
	literature[1, 2, 3, 4]	
	Task on SRS: Error when calculating by the above method.	
	literature[1, 2, 3, 4]	
9	*Calculation of definite integrals with a given error.*	*4*
	literature[1, 2, 3, 4]	
	Task on SRS: Error when calculating by the above method.	
	literature[1, 2, 3, 4]	

Practical training

Applicants should be helped to develop creative thinking, a creative approach to the scientific substantiation of the research direction and methodology. The main tasks of the cycle of practical classes:

- *to help applicants deepen their theoretical knowledge in the field of processes and technology of primary gas and oil refining;*
- *to promote the training of miners in the methodology of determining the properties of oils and the peculiarities of their processing;*
- *form criteria for evaluating the efficiency of primary gas and oil refining processes.*

No s/p	***The name of the subject of the practical session and a list of the main questions (list of didactic support, references to the literature and tasks on the SRS)***	***Number hours***
	Chapter 1. Use of numerical methods.	
	Topic 1.1 Numerical solution of equations.	
1	*The main methods of numerical solution of transcendental equations are considered. Method of halving. The Horner-Ruffini method. . Newton's method, chord method.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Calculation of error in iterative calculations	
	literature[1, 2, 3, 4]	
2	*Gauss method for calculating systems of linear equations.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Iterative method of Gauss	
	literature[1, 2, 3, 4]	
3	*Newton's method for calculating systems of nonlinear equations.*	*2*
	literature[1, 2, 3, 4]	
	Tasks on SRS: Other methods of calculating systems of nonlinear equations.	
	literature[1, 2, 3, 4]	
	Chapter 2. Combined problems.	
	Topic 2.1 Basic principles of working with one-dimensional arrays.	
4	*Creating a one-dimensional array. Its input-output methods. Finding the minimum and maximum elements in a one-dimensional array. Sorting a one-dimensional array.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Converting a string to an array.	
	literature[1, 2, 3, 4]	
	Topic 2.2 Basic principles of working with two-dimensional arrays.	
5	*Creating a two-dimensional array. Its input-output methods. Finding the minimum and maximum elements in a two-dimensional array. Sorting a two-dimensional array.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Converting a string to an array.	
	literature[1, 2, 3, 4]	
	Chapter 3. Numerical integration.	

	Topic 3.1 Calculation of definite integrals.	
6	*Introduction to numerical integration. The geometric meaning of the definite integral. Application of numerical methods.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Repeat tabular integrals for the purpose of self-checking	
	literature[1, 2, 3, 4]	
7	*Calculation of definite integrals using the methods of left-sided, right-sided, central rectangles and the method of trapezoids.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Error when calculating by the above methods.	
	literature[1, 2, 3, 4]	*2*
8	*Calculation of definite integrals by the Simpson method*	
	literature[1, 2, 3, 4]	
	Task on SRS: Error when calculating by the above method.	
	literature[1, 2, 3, 4]	
9	*Calculation of definite integrals with a given error.*	*4*
	literature[1, 2, 3, 4]	
	Task on SRS: Error when calculating by the above method.	
	literature[1, 2, 3, 4]	
	Chapter 4. Approximation of functions.	
	Topic 4.1 Interpolation formulas.	
10	*Definition of interpolation, scope of its application. Examples of interpolation in different cases.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: To reveal the methods of interpolation in various fields of science.	
	literature[1, 2, 3, 4]	
11	*Lagrange interpolation polynomial. Definition and calculation.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Polynomial error.	
	literature[1, 2, 3, 4]	
12	*Newton's interpolating polynomial. Definition and calculation.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Polynomial error.	
	literature[1, 2, 3, 4]	
13	*Spline interpolation.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Polynomial error.	
	literature[1, 2, 3, 4]	
	Topic 4.2 Approximation of functions.	
14	*Definition of approximation. Field of application.*	*2*
	literature[1, 2, 3, 4]	
	Tasks on SRS: Application of approximation in solving scientific problems.	
	literature[1, 2, 3, 4]	

15	*Approximation by the method of selected points. Definition and calculation.*	
	literature[1, 2, 3, 4]	
	Task on SRS: Method error.	
	literature[1, 2, 3, 4]	
16	*Approximation by the method of averages. Definition and calculation.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Method error.	
	literature[1, 2, 3, 4]	
17	*Approximation by the method of least squares. Definition and calculation.*	*2*
	literature[1, 2, 3, 4]	
	Task on SRS: Method error.	
	literature[1, 2, 3, 4]	
18	*Modular control work*	*2*

5. Independent work of student

Independent work makes up 50% of the study of the credit module, which includes preparation for the credit. The main task of the independent work of graduate students is to deepen worldview and scientific knowledge in the directions specified in the lectures, by searching for the necessary information, forming perseverance and creative search in the formation of working hypotheses for the intensification of transfer processes.

Policy and control

6. Policy of academic discipline (educational component)

Rules of attending classes and behavior in classes

Attending classes is mandatory. Students are obliged to take an active part in the educational process, not to be late for classes and not to miss them without valid reasons, not to interfere with the teacher conducting classes and not to be distracted by activities unrelated to the educational process.

Rules for assigning incentive and penalty points

- *incentive points can be awarded by the teacher exclusively for the performance of creative works and working hypotheses.*
  But their sum cannot exceed 25% of the rating scale.
- *Penalty points are not provided within the academic discipline.*

Policy of deadlines and rescheduling

In case of academic debts arising from the academic discipline or any force majeure circumstances, graduate students should contact the teacher to coordinate the algorithm of actions related to solving existing problems.

Policy of academic integrity

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism refers to the absence of references when using printed and electronic materials, quotes, opinions of other authors. Inadmissible tips and write-offs during writing tests, conducting classes.
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

Policy of academic behavior and ethics

Graduate students must be tolerant, respect the opinion of others, formulate objections in the correct form, adequately support feedback during classes.

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

7. Types of control and rating system for evaluating learning outcomes (RSO)

Distribution of study time by types of classes and tasks in the discipline according to the working study plan:

Semester	Training time		Distribution of study hours				Control measures		
	Credits	Acad. hours	Lectures	Practical	Lab. do	SRS	MKR	RR	Semester control
6	5.5	165	18	36	–	26	1	–	test

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

The rating of the graduate student from the credit module consists of the points he receives for work in practical classes, lectures and MKR.

Semester control is an exam.

System of rating (weighted) points and evaluation criteria

The system of rating points and evaluation criteria:

Performing tasks in practical classes.

Weighted points for lectures are 1 point each

The weighted score for practical classes is 4 points each;

The weighted score for MKR is 15 points

Weighted score for the exam is 15 points

Criteria for evaluating the performance of a practical task

Completeness and signs of task completion	***Points***
The task is fully completed	*4*
Minor defects according to point 1	*3*
Untimely completion of the task	*2.5*
Untimely completion of the task, deficiencies under clause 1	*2*
Poor performance of the task	*1*
Failure to complete the task	*0*

Thus, the rating semester scale for the credit module is:

$$R = 34 \cdot 1 + 4 \cdot 8 + 1 \cdot 15 + 1 \cdot 16 = 100 \text{ points}$$

According to the results of educational work in the first 7 weeks, the "ideal student" should score 40 points. At the first certification (8th week), the student receives "credited" if his current rating is at least 20 points.

According to the results of academic work for 13 weeks of study, the "ideal graduate student" should score 90 points. At the second certification (14th week), the graduate student receives "credited" if his current rating is at least 40 points.

The maximum number of points is 100. To receive credit from the credit module "automatically" you need to have a rating of at least 60 points.

A necessary condition for admission to credit is a rating of at least 40% of the rating scale (R), i.e. 40 points.

Postgraduate students who scored less than 0.6 R during the semester, as well as those who want to improve the overall rating, complete a credit test. At the same time, all the points they received during the semester are cancelled. Test tasks contain questions that refer to different sections of the credit module. The list of assessment questions is given in Chapter 9.

To obtain a passing grade, the sum of all rating points R received during the semester is converted according to the table:

Scores	***Rating***
95...100	*perfectly*
85...94	*very good*
75...84	*fine*
65...74	*satisfactorily*
60...64	*enough*
RD<60	*unsatisfactorily*
Admission conditions not met	*not allowed*

8. Additional information on the discipline (educational component)

An approximate list of questions submitted for semester control

The ticket consists of three questions

- *General view of the working window of the MS-Word editor.*
- *Analyze the commands of the quick access panel, reveal the principles of its configuration.*
- *Basic principles of text formatting.*
- *Page formatting: indents and spacing, page options.*
- *Formation of footers: designer of footers.*
- *Principles of working with tables: creation, editing, designer.*
- *Working with the built-in formula editor.*
- *Working with the built-in graphics editor: basic shapes, principles of formatting.*
- *Creating a document with different page orientations.*
- *Working with MS-Word built-in programs.*
- *General view of the working window of the MS-Excel editor.*
- *Analyze the commands of the quick access panel, reveal the principles of its configuration.*
- *Cell formatting: discover formats and principles of operation.*
- *Creating formulas: relative and absolute cell references.*
- *Work with charts: Create graphs and charts based on existing data.*
- *Principles of solving transcendental equations.*
- *Method of halving: derivation and conditions of application.*
- *The Horner-Ruffini method: derivation and application conditions.*
- *Method of tangents: derivation and conditions of application.*
- *Chord method: derivation and application conditions.*
- *Principles of solving systems of linear equations.*
- *Gauss method: derivation and application conditions.*
- *Principles of solving systems of nonlinear equations.*
- *Newton's method: derivation and application conditions.*
- *Principles of iterative methods for solving nonlinear equations.*

Working program of the academic discipline (syllabus):

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Agreed by the Methodical Commission of the faculty (protocol No. 10 dated 05/26/2023)