Silabus
educational component of the UA
(elective discipline)

Fundamentals of computer-aided design of machines

Name of the discipline:	**Fundamentals of computer-aided design of machines**
Level of higher education:	**first (bachelor)**
Course page in Moodle:	https://dl2022.khadi.kharkov.ua/course/view.php?id=731
The volume of the educational component	**3 credits (90 hours)**
Form of final control	**Offset**
Consultations:	**on schedule**
Name of the department:	**Department of Construction and Road Machines**
Language of instruction:	**Ukrainian**
Course leader:	**Shcherbak Oleg Vitaliyovych, PhD, Associate Professor**
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Summary of the educational component:

The aim is to prepare students for specialized activities in the field of computer-aided design (CAD) systems implemented by means of personal computers.

Subject*:* basics of professional work in modern computer-aided design systems.

The main tasks of studying the discipline are:

-acquaintance with the current state and possibility of using personal computers and specialized software in the design of road construction machines (RCM) and equipment;

- studying the principles of using personal computers to perform design work on the calculation of paper machines;

-apply methods of design, construction and research of machine tools and equipment by means of personal computers based on the use of individual software tools and software systems;

- to carry out traditional design training with the ability to carry out computer-aided design and construction of machine tools, equipment.

Prerequisites for studying the educational component:

Descriptive geometry, engineering and computer graphics

Competencies acquired by the applicant:

General competencies:

Ability to gather and interpret information and make judgments on relevant social, scientific or ethical issues.

Ability to critically comprehend the theories and principles that underlie the design of lifting and transport, construction, road and land reclamation machines.

Special (professional) competencies:

Ability to apply fundamental scientific facts, concepts, theories, principles to solve professional problems and practical problems of industrial engineering.

Ability to use computer-aided design systems and specialized application software to solve engineering problems in the field of mechanical engineering.

Learning outcomes in accordance with the educational program:

Analyze engineering objects, processes and methods.

Prepare production and operate products using automatic life cycle support systems.

Develop machine parts and assemblies using computer-aided design systems.

Knowledge and ability to use methods of optimization of parameters of lifting and transport, construction, road and land reclamation machines to achieve the required performance indicators.

Thematic plan

no. of topics	Name of topics (LC, LR, PR, NW, SR)	Number of hours	
		face-to-face	correspondence
1	LK-1. Fundamentals of computer-aided design of machines Introduction. Fundamentals of CAD. Classification of CAD. History of CAD development. Product life cycle. CAD market. An example of the use of CAD in mechanical engineering.	2	1
	PR-1. Construction of shoe brakes in the 3D modeling environment COMPASS 3D. Construction of shoe brake elements: right and left rack.	4	2
	CP. Computer-aided design system KOMPAS 3D. Construction of drawings	6	10
2	LK-2. Skid 3-D technology from ASCON. Products of the company ASCON. Through 3D technology. Planning and management of production preparation.	2	
	PR-2. Construction of shoe brakes in the 3D modeling environment COMPASS 3D. Construction of shoe brake elements: Elements of the brake shoe.	4	2
	CP. Computer-aided design system KOMPAS 3D. Learn what end-to-end 3D technology is, where it is used.	6	10
3	LK-3. The product line of Dassault Systèmes. History of Dassault Systèmes company. CATIA program capabilities, scope of application. SolidWorks computer modeling system from Dassault Systèmes. PLM modules from Dassault Systèmes	2	
	PR-3. Construction of shoe brakes in the 3D modeling environment COMPASS 3D. Construction of shoe brake elements	4	
	SR. Perform the construction of a simple part using the CATIA program.	6	10
4	LC-4. The main software modules of Parametric Technology Corporation. Famous clients of Parametric Technology Corporation (PTC). Academic programs of Parametric Technology Corporation. PTC Creo Behavior capabilities scope	2	1

	of application. Creo Mechanism Dynamics capabilities, scope of application. Creo MathCAD capabilities, scope of application. Creo WildFire capabilities, scope of application		
	PR-4. Construction of finger coupling with elastic jumps in SolidWorks environment	4	
	SR. Get acquainted with the capabilities of the Creo Mechanism Dynamics, Creo MathCAD system.	6	10
5	LK-5. Siemens PLM. History of the development of Siemens PLM Software. Programs that are included in Siemens PLM Software. Enterprise Resource Planning system. Manufacturing Execution System. Supply Chain Management system, the main software products of the company. Teamcenter, Fibersim, SyncroFIT. Technologies and components.	2	1
	PR-5. Construction of a load hook of a lifting suspension using the Solid Works environment.	4	2
	CP. Get acquainted with the capabilities of the Siemens PLM system	6	10
6	LK-6. Features of the NX program. Functionality of the NX CAM system. Model-oriented preparation process in a single environment. Manufacturing of parts on CNC machines. Adaptive milling. SolidEdge program. Calculation modules NX Nastran, Femap. LMS solutions for modeling and testing.	2	1
	PR-6. Construction of a cargo hook of a lifting suspension using the SolidWorks environment.	4	
	CP. Get acquainted with the capabilities of the NX system	4	10
7	LK-7. Modern CAE systems for engineering calculations. CAE software market. Software complex MSC NASTRAN. ABAQUS finite element complex. Stages of development of the ANSYS software complex. ANSYS Workbench platform. ANSYS AIM tool.	2	
	PR-7. Building a shoe brake using the Solid Works environment.(Part 1)	4	
	SR Get acquainted with the capabilities of ANSYS Workbench	4	10
8	LK-8. Optimization of technical solutions by means of CAD. Topological optimization. Generative design.	2	
	PR-8. Building a shoe brake using the Solid Works environment.(Part 2)	4	
	CP - To get acquainted with the programs that can be used to optimize machine designs.	4	10
Together	LC	16	4
	SOFTWARE	32	6
	SR	42	80

Individual educational and research task (if available):

Teaching methods:

MH1 - verbal method (lecture, explanation, story);

MH2 - practical method (practical classes);

МН3 - visual method (method of illustrations, method of demonstrations);
МН4 - work with literature (educational and methodological; work with textbooks and manuals);

Forms and methods of evaluation

FMO2 - final control (offset);
FMO3 - oral control (conversation);
FMO4 - written control (individual tasks);
FMO5 - test control;
FMO7 - practical examination (defense of practical works).

Evaluation system and requirements:

Current academic performance

1 The current performance of applicants for the performance of educational types of work in class and for the performance of independent work tasks is assessed using a four-point grading scale with the subsequent conversion to a 100-point scale. When assessing current progress, all types of work provided by the curriculum are taken into account.

1.1 Lecture classes are evaluated by determining the quality of specific tasks.

1.2 Practical classes are evaluated by the quality of the control or individual task, performance and design of practical work.

1.3 Laboratory classes are evaluated by the quality of laboratory reports.

1.4 Seminar classes are evaluated by the quality of individual assignments / essays.

2 Evaluation of the current progress of higher education students is carried out at each practical lesson (laboratory or seminar) on a four-point scale ("5", "4", "C", "2") and recorded in the academic record.

- "excellent": the applicant has flawlessly mastered the theoretical material, demonstrates deep knowledge of the relevant topic or discipline, the main provisions;

- "good": the applicant has mastered the theoretical material well, knows the main aspects of the primary sources and recommended literature, reasonably presents it; has practical skills, expresses his thoughts on certain problems, but makes certain inaccuracies and errors in the logic of the presentation of theoretical content or in the analysis of practical content;

- "satisfactory": the applicant has basically mastered the theoretical knowledge of the subject or discipline, is oriented in the primary sources and recommended literature, but unconvincingly answers, confuses concepts, hesitates to answer additional questions, does not have stable knowledge; answering questions of a practical nature, shows inaccuracy in knowledge, is unable to evaluate facts and phenomena, to relate them to the future profession;

- "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), does not know scientific facts, definitions, is almost not oriented in primary sources and recommended literature, there is no scientific thinking, practical skills are not formed.

3 The final score for the current activity is recognized as the arithmetic mean of points for each class, for individual work, current control works according to the formula:

$$K^{поточ} = \frac{K1 + K2 + ... + Kn}{n},$$

where $K^{поточ}$ is the final assessment of success based on the results of the current control;

$K1, K2, ..., Kn$ - assessment of the success of the n current control measure;

n - number of current control measures.

Scores are converted into points according to the conversion scale (Table 1).

Table 1 - Conversion of the average score for the current activity into a multi-point scale

4-point scale	100-point scale	4-point scale	100-point scale	4-point scale	100-point scale	4-point scale	100-point scale
5	100	4,45	89	3,90	78	3,35	67
4,95	99	4,4	88	3,85	77	3,3	66
4,9	98	4,35	87	3,80	76	3,25	65
4,85	97	4,3	86	3,75	75	3,2	64
4,8	96	4,25	85	3,7	74	3,15	63
4,75	95	4,20	84	3,65	73	3,1	62
4,7	94	4,15	83	3,60	72	3,05	61
4,65	93	4,10	82	3,55	71	3	60
4,6	92	4,05	81	3,5	70	from 1.78 to 2.99	from 35 to 59
						reassembly	
4,55	91	4,00	80	3,45	69	from 0 to 1.77	from 0 to 34
4,5	90	3,95	79	3,4	68	re-examination	

Final evaluation

1 A higher education student receives a credit at the last class of the discipline based on the results of the current assessment. The average grade for the current activity is converted into points on a 100-point scale, according to the conversion table (Table 1).

Higher education applicants who have a current average grade in the discipline below "3" (60 points) in the last class can increase their current score by taking tests in the discipline.

Assessment of knowledge of applicants by testing is carried out on a scale:

- "Excellent": at least 90% of correct answers;
- "Very good": from 82% to 89% of correct answers;
- "Good": from 74% to 81% of correct answers;
- "Satisfactory": from 67% to 73% of correct answers;
- "Satisfactory enough": from 60% to 66% of correct answers;
- "Unsatisfactory": less than 60% of correct answers.

2 The condition for receiving credit is:

- working off all missed classes;
- the average current grade in the discipline is not lower than "3" (60 points).

3 Additional points are awarded for individual independent work and participation in scientific events.

3.1 Additional points are added to the sum of points gained by the applicant for higher education for the current educational activity (for disciplines, the final form of control for which is a test), or to the final grade in the discipline, the final form of control for which is an exam.

3.2 The number of additional points awarded for different types of individual tasks depends on their volume and significance:

- prizes in the discipline at the international / all-Ukrainian competition of scientific student works - 20 points;
- prize places in the discipline at the national competitions - 20 points;
- participation in the international / all-Ukrainian competition of scientific student works - 15 points
- participation in international/national scientific conferences of students and young scientists - 12 points;

- participation in national competitions in the discipline - 10 points
- participation in Olympiads and scientific conferences of KhNADU in the discipline - 5 points;
- performance of individual research (educational and research) tasks of increased complexity - 5 points**.**

3.3 The number of additional points cannot exceed 20 points.

4 The learning outcome is evaluated *(select the required)*:

- on a two-point scale (passed/not passed) according to Table 2;
- on a 100-point scale (knowledge assessment scale) according to Table 3.

The final score together with additional points cannot exceed 100 points.

Table 2 - Scale of points conversion to the national evaluation system

On a 100-point scale	**On the national scale**
from 60 points to 100 points	enrolled
less than 60 points	unaccounted for

Table 3 - Scale for assessing the knowledge of students based on the results of the final control of the discipline

Score in points	Assessment on the national scale		Evaluation on the ECTS scale	
	examination	offset	Evaluation	Criteria.
90-100	**That's great.**	**Enrolled**	**A**	The theoretical content of the course is mastered completely, without gaps, the necessary practical skills of working with the mastered material are formed, all the training tasks provided by the training program are completed, the quality of their implementation is estimated by the number of points close to the maximum
80-89	**Okay.**	**Enrolled**	**B**	The theoretical content of the course is mastered completely, without gaps, the necessary practical skills of working with the mastered material are basically formed, all the training tasks provided by the training program are completed, the quality of most of them is estimated by the number of points close to the maximum
75-79			**C**	The theoretical content of the course is fully mastered, without gaps, some practical skills of working with the mastered material are insufficiently formed, all the training tasks provided by the curriculum are completed, the quality of any of them is not evaluated by the minimum number of points, some types of tasks are performed with errors

<table>
<tr><td rowspan="2">Score in points</td><td colspan="2">Assessment on the national scale</td><td colspan="2">Evaluation on the ECTS scale</td></tr>
<tr><td>examination</td><td>offset</td><td>Evaluation</td><td>Criteria.</td></tr>
<tr><td>67-74</td><td rowspan="2">Satisfactory</td><td rowspan="2"></td><td>D</td><td>The theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills of working with the mastered material are basically formed, most of the training tasks provided by the curriculum are completed, some of the completed tasks may contain errors</td></tr>
<tr><td>60-66</td><td>E</td><td>The theoretical content of the course has been mastered partially, some practical skills have not been formed, many of the training tasks provided by the training program have not been completed, or the quality of some of them is estimated by the number of points close to the minimum.</td></tr>
<tr><td>35-59</td><td>Unsatisfactory</td><td rowspan="2">Not enrolled</td><td>FX</td><td>The theoretical content of the course is partially mastered, the necessary practical skills have not been formed, most of the learning tasks provided by the curriculum have not been completed, or the quality of their implementation is estimated by the number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of learning tasks (with the possibility of repeating)</td></tr>
<tr><td>0-34</td><td>Unacceptable.</td><td>F</td><td>The theoretical content of the course has not been mastered, the necessary practical skills have not been formed, all completed training tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of training tasks (with a mandatory repeated course)</td></tr>
</table>

Policy of the course:

- the course involves teamwork, the environment in the classroom is friendly, creative, open to constructive criticism;
- mastering the discipline involves mandatory attendance of lectures and practical classes, as well as independent work;
- independent work involves the study of individual topics of the discipline, which are submitted in accordance with the program for independent study, or were considered briefly;
- all tasks provided by the program must be completed in due time;
- if the applicant for higher education is absent from classes for a valid reason, he/she presents the completed tasks during independent preparation and consultation of the teacher;

- the term paper must be defended no later than one week before the start of the examination session**;**
- while studying the course, higher education students must adhere to the rules of academic integrity set out in the following documents: "Rules of academic integrity of participants of the educational process of KNADU" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.pdf), "Academic integrity. Checking the text of academic, scientific and qualification papers for plagiarism" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_85_1_01.pdf), "Moral and ethical code of participants of the educational process of KNADU (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.pdf).
- in case of detection of the fact of plagiarism, the applicant receives 0 points for the task and must repeat the tasks provided in the silabus;
- cheating during tests and exams is prohibited (including using mobile devices). Mobile devices are allowed to be used only during on-line testing.

Recommended literature:

1. Fundamentals of computer modeling: textbook / M.S. Barabash, P.M. Kiryazev, O.I. Lapenko, M.A. Romashkina. 2nd ed. - K.: NAU, 2019. - 492 p.
2. Timchenko A. A. Fundamentals of system design and system analysis of complex objects: Fundamentals of CAD and system design of complex objects: Textbook / edited by. Bykov V.I. - 2nd ed. - K.: Lybid, 2003. - 272 p.
3. Babicheva O. F. Computer-aided design of electromechanical devices, components of digital control systems and diagnostic complexes: textbook / O. F. Babicheva, S. M. Esaulov. Babicheva, S. M. Esaulov ; Kharkiv National University of Urban Economy named after A. M. Beketov - Kharkiv: KhNUMG named after A. M. Beketov, 2018. 355 p.
4. Shcherbak O., Ragulin V., Suminov A. Analysis of the load-bearing system of the loader according to the results of dynamic tests in the environment of Ansys motion Automobile Transport, Vol. 51, 2022. 58-65.
5. Shcherbak O. V. Development of a methodology for designing specialized machines based on an articulated tractor / O. V. Shcherbak, A. V. Suminov, S. L. Khachaturyan // Bulletin of KhNADU. - 2021. - №95. - P. 38-42.

Additional sources:

1 File archive of the Department of DBM KhNADU (http://files.khadi.kharkov.ua/mekhanichnij-fakultet/budivelnikh-i-dorozhnikh-mashin.html)

2 KHNADU training website *(https://dl2022.khadi.kharkov.ua/course/view.php?id=731)*

3 NTB KhNADU (25 Yaroslav Mudryi St., Kharkiv)[electronic resource] . (http://library.khadi.kharkov.ua/)

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