



Силабус освітнього компонента
Програма навчальної дисципліни



"Assembly Technological Processes of Mechanical Engineering Products"

Шифр та назва спеціальності
131 - Applied mechanics

Освітня програма
Applied mechanics

Рівень освіти
Bachelor

Семестр
8

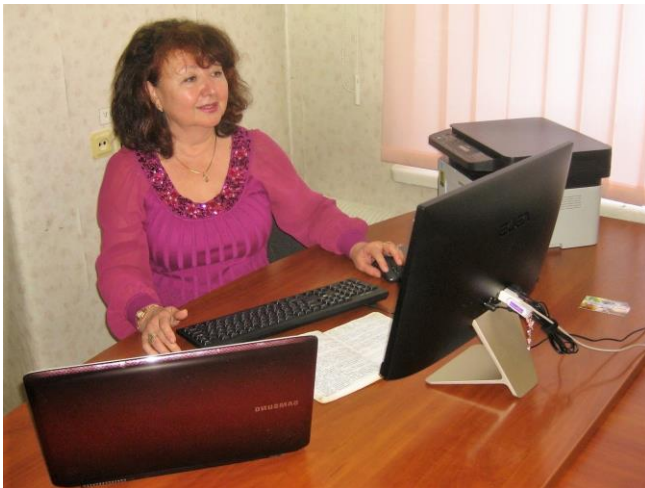
Інститут
NNI of Mechanical Engineering and Transport

Кафедра
Mechanical engineering technology and metal cutting machines (146)

Тип дисципліни
Special (professional) training, selective

Мова викладання
English

Викладачі, розробники



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Associate Professor, Candidate of Technical Sciences, Associate Professor of the department "Technology of mechanical engineering and metal-cutting lathes" KhPI. Work experience - 30years. Author of more than 70 scientific and educational and methodological works. Leading lecturer in the disciplines: "BASICS OF TECHNOLOGICAL FORECASTING ", " Technological processes of folding machines and machines ", "TECHNOLOGICAL EQUIPMENT"

[Детальніше про викладача на сайті кафедри](#)

Загальна інформація

Анотація

Course "Technological processes of assembly of mechanical engineering products"

The discipline is aimed at mastering the theoretical foundations and systematized knowledge of the theoretical foundations of the technology of assembly of parts, which are necessary for a mechanical engineer in managing the production processes of machine-building production, mastering the theoretical foundations, principles, and methods of assembly, calculation or selection of technological equipment, cutting modes, modern cutting tools, technological equipment.

Мета та цілі дисципліни

Purpose: acquisition by students of a system of knowledge and skills regarding design and justified selection of assembly technological processes in the conditions of modern mechanical engineering, ensuring all requirements for accuracy, quality, and productivity in various types of production. To give students the necessary knowledge and skills in the design of technological processes of assembly of various types of products and organizational forms of assembly work, the ability to reasonably determine the appropriate method and method of technological processes of assembly of mechanical engineering products depending on the size, accuracy, mass, production program.

Формат занять

Lectures, laboratory work, practical classes, independent work, consultations. The final control is an exam.

Компетентності

ZK04. Ability to apply knowledge in practical situations

ZK05. Knowledge and understanding of the subject area and understanding of professional activity.

ZK09. Ability to learn and master modern knowledge.

FK05. The ability to identify, formulate, and solve a wide range of applied mechanics problems based on an understanding of their fundamental causes and the use of theoretical and experimental methods learned in the curriculum.

FK06. Ability to apply appropriate quantitative mathematical, scientific, and technical methods, as well as computer software to solve engineering problems in applied mechanics.

FK07. The ability to model, design, and optimize technological processes in mechanical engineering, which is based on deep knowledge and understanding of a wide range of mechanical theories and practices, as well as basic knowledge of related sciences.

FK08. The ability to acquire new knowledge and skills through independent study, using already acquired professional and general scientific knowledge and skills

K014. The ability to critically analyze, evaluate, and synthesize new and complex ideas in the process of developing and implementing mechanical structures, machines, materials, and production processes of mechanical engineering based on the latest knowledge in the field of mechanics and related subject areas.

K017. The ability to clearly and unambiguously convey one's conclusions, knowledge, and explanations to specialists and non-specialists, particularly in the process of teaching activities, and oral and written presentation of the results of one's scientific research in Ukrainian.

K019. The ability to critically analyze problems in education, professional, and research activities at the level of the latest achievements of engineering sciences and at the boundaries of subject areas.

K021. The ability to apply appropriate mathematical, scientific, and technical methods, information technologies, and applied computer software to solve engineering and scientific problems in applied mechanics..

Результати навчання

PR07. To know and understand modern research methods of mathematical methods and information technologies of mathematical and computer modeling of complex systems, system analysis and design, optimization and decision-making, forecasting, and expert evaluation.

PR013. The ability to speak in front of an audience: present educational material, lead a discussion, and defend one's position with arguments. Know how to develop professionally and improve your teaching skills.

PR024. To know and understand modern methods of modeling, design, and optimization of technological processes in mechanical engineering.

PR025. To know and understand modern methods of creating life cycle support systems for mechanical engineering products..

Обсяг дисципліни

The total volume of the discipline is 120 hours. (4 ECTS credits): lectures – 32 hours, laboratory work – 16 hours, independent work – 72 hours.

Передумови вивчення дисципліни (пререквізити)

To complete the course, you must have the knowledge and practical skills in the following disciplines: "Modeling, design, and optimization of technological processes in mechanical engineering", "Technology of automated mechanical engineering production", "Technological processes of assembly of mechanical engineering products".

Особливості дисципліни, методи та технології навчання

Teaching methods:

- the educational project, which conceptually consists of "learning through activity" is used mainly in practical work (rarely in lectures). Application of the method involves providing students with a wide enough set of projects to realize the possibility of a real choice. It should be noted that projects can be both individual and collective. The latter, among other things, contribute to the student's mastering of collective work methods. In order to master the project method of work, the student is provided with instructions on working on the project (methodological instructions). Each educational project involves obtaining a final result using improvised material on the topic of work, the results of which become a reference for obtaining a final assessment. Collective discussion of difficult moments in solving the given task forms the terrain of collective work and is a positive experience for both the student and the teacher.
 - The project method is mainly focused on mastering the methods of working with DHW. An obligatory component of the learning process is control, or verification of learning results. The essence of checking the learning results is to identify the level of knowledge acquisition by students, which must meet the educational standard of the academic discipline.
 - Explanatory and illustrative method, which involves the use of visual lecture material in the form of tables, posters, presentations made in the MS Power Point environment.
 - Reproductive method used in performing practical work and solving typical tasks.
 - The method of stimulating and motivating learning is applicable when encouraging students to independently study the materials of the discipline (the possibility of receiving motivational additional points for active work in classes, when preparing reports or completing a calculation task in advance).
 - Methods of control and self-control, which involve checking current knowledge with instant surveys or short-term tests at the beginning of the lesson, as well as planned modular controls.
- Mastering the discipline involves constant contact between the teacher and the student through a conversation, lecture, story, shows, demonstrations, self-study, independent work, generalization and classification of the information received, etc

Програма навчальної дисципліни

Теми лекційних занять

Topic 1. Module 1

Topic 1. Basic concepts of assembly technology.

1. Analysis of raw data for the development of technological processes of scaling.
2. Analysis of the manufacturability of the part
3. Choosing a strategy

Maximum provision of design requirements, provision of specified accuracy of product parameters, level of mechanization and automation of assembly processes, differentiation of assembly processes, specialization of workplaces; parallelism and directness of assembly processes).. Analysis of service purpose and conditions of assembly of shafts. Formation of the characteristics of the quality of the working surfaces of the shafts, which ensures the operational characteristics of the machine.

Topic 2. The theory of design of technological processes of assembly Methodology of design of technological processes of assembly

1. Selection of the surface treatment method. Other methods of assembling parts. 2. The quality of assembly transitions. 3. Designing assembly transitions Test task

Algorithm for substantiating the choice of technological bases for the technological process of manufacturing general-purpose shafts. Typical technological sequences of processing general technological bases, slotted, threaded, and toothed surfaces.

Topic 3. Preparation of parts for assembly

1. Locksmith and fitting works, lapping, polishing, scraping, drilling, leveling, washing of parts and assembly units
2. Accuracy of assembly and methods of ensuring it.

Test task

Topic 4. Examples of implementation of design functions and procedures in modern MCAD (Mechanical Computer-Aided Design). Effectiveness of implementation of CAD TP

. The Unigraphics system is a universal system of geometric modeling and engineering and technological design, including the development of large assemblies, strength calculations, and preparation of design documentation. It uses the concept of master processes - interactive design tools that take into account the specifics of specific programs. The design part (CAD subsystem) has tools for solid construction, geometric modeling based on splines of surface models, creation of drawings based on a 3D model, design of assemblies (including hundreds and thousands of components) taking into account associativity, analysis of tolerances, and so on. Parasolid is used as a graphics core. The technological part (SAM subsystem) provides for the development of control programs for turning and EDM, synthesis and analysis of tool trajectories during milling for three- and five-coordinate processing, during the design of molds and stamps, etc. For engineering analysis (CAE subsystem), the system includes modules for strength analysis using MSE with appropriate preprocessors and postprocessors, kinematic and dynamic analysis of mechanisms with determination of forces, velocities and accelerations, analysis of foundry processes of plastic masses, etc.

The main economic results obtained from the implementation of CAD TP:

- increasing the work productivity of the technological engineer;
- increasing the technical level of development and minimizing the number of design errors;
- shortening the terms of technological preparation of production;
- accumulation and application of the company's knowledge base on the technological design of new products and the organization of a single information and reference space for technologists and designers, as well as production management services;
- improvement of executive control

Topic 5. Peculiarities of assembling fixed detachable joints.

1. Classification of parts connections during assembly. Assembling threaded, keyed, and splined joints
2. Assembling fixed conical joints. Assembling fixed joints using plastic compensators.
3. Features of assembly of bolted and screw connections

Test task

Summary of the module

Content module No. 2 Assembling fixed fixed connections

Topic 6. Assembling fixed non-separable connections.

3. Classification of parts connections during assembly.

4. Assembling threaded, keyed and splined joints

Topic 7. Assembly of typical assembly units.

6. Assembly of shafts and couplings.

7. Assembling connections with sliding and rolling bearings.

8. Assembling joints with flat surfaces

9. Assembly of movable conical joints.

10. Assembly of toothed and worm joints.

: Features of assembly of threaded connections.

Test task/Summary for the module/Rating

Topic 7 Classification of simulation models of details processing process parameters

Simulation models can be classified according to the four most common features:

- type of computer used;
- method of interaction with the user;
- method of system time management (system time mechanism);
- a method of organizing quasi-parallelism (scheme of formalization of the simulated model).

Topic 8. Modeling of interrelationships of the technological influence of the cycle of creation and manufacture of CAD/CAM/CAE/DEFORM 3D products

Selection and designation of the metrological support system for the parameters of the surface layer of parts that determine their operational properties

Topic 9. Optimization of technological processes in mechanical engineering.

Generalization and development of the basics of optimal technological support of the operational properties of parts;

Development of technological bases of conversion, reconstruction and technical rearmament of aviation production.

Increasing the technological efficiency of machining processes on CNC machines based on research using laser and holographic interferometry of the stress-strain and thermal state of the cutting tool.

Mathematical modeling and optimization of science-intensive technological processes;

Ion-plasma modification of the surface of parts with the aim of repeatedly increasing their operational properties;

Scientific foundations and methods of solving technological problems based on various design and technological models.

Topic 10. Simulation modeling in the tasks of technological engineering of systems for processing parts by cutting.

Technological engineering of the enterprise level or its localized divisions (workshop, district):

1 - "direct task" - achieving the initial production indicators according to the release program and cost price while ensuring restrictions on the quality and accuracy of products;

2 - "reverse task" - technological substantiation of the optimal selection of the required composition of equipment, its placement and optimization of resource flows under the given technical and production requirements for the manufactured products.

A direct task allows you to generate alternative variants of the organization system of "virtual machine-building factories" that are subject to design optimization. The critical task minimizes equipment distribution costs under the selected optimal design solution with a given model of production organization

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Теми практичних занять

Topic 1 Preparation and analysis of raw data for the design of technological processes. Development of assembly technology.

Topic 2. Devices and tools for assembly works.

Topic 3. Features of assembly technology development (differentiation, process concentration, breakdown into assembly units).

Topic 4. Development of a technological scheme of the assembly process.

3. Standardization of assembly works.

Topic 5. Basics of building assembly technological processes

Теми лабораторних робіт

Topic 1. Uncertainty of measurement

Topic 2. Accuracy class of devices

Topic 3. Systematic and random errors and

Topic 4. Determination of the systematic component of measurement error. Checking and calibration of devices.

Topic 5. Construction of an empirical distribution curve.

Topic 6. Basic theoretical laws of distribution

Самостійна робота

. The course involves writing an essay on a given topic and presenting it using the system as a basis for designing the structure of route technological processes and the content of technological operations.

Design of the generalized technological process of assembly. Analysis of service purpose and conditions of assembly of spindles of metal cutting machines. Formation of the characteristics of the quality of the working surfaces of the spindles, which ensures the operational characteristics of the machine.

Construction materials, methods, and methods of manufacturing blanks. Algorithm for substantiating the

choice of technological bases for the technological process of assembling a lathe spindle. manufacturing a complex shaft

Practical classes require the completion of an individual task for the development of a technological process of drawing up a calculation task of mechanical engineering, which is drawn up in a written report. Laboratory work is performed on a PC, the results are provided in the form of separate files. Students are also recommended additional materials (videos, articles) for independent study and analysis

Література та навчальні матеріали

1. Mechanical engineering technology: Handbook for the performance of qualification works: training. manual / I.I. Yurchyshyn, Y.M. Lytvynyak, I.E. Hrytsai and others; under the editorship I.I. Yurchyshyn - Lviv: publishing house of Lviv Polytechnic University, 2009. - 527 p.
 2. Watchman B.D. Technological basics of mechanical engineering / B.D. Storozh, M.L. Mazur. - Iv. Frankivsk, Khmelnytskyi: TUP, 2003. - 153 p.
 3. Simulation modeling in the problems of machine-building production in 2 volumes, T. 2: 4. ed. manual / edited by O.M. Shovkovo // - Kh.: NTU "KhPI", 2015. - 400 p.
 4. Fedina, L. V. Mechanical engineering technology [Text]: textbook / L. V. Fedina, O. M. Hnytko, A. V. Kuznetsova; under the editorship O. M. Hnytko. - Kharkiv: National. aerospace University named after M. E. Zhukovsky "Kharkiv. aviation Institute of Technology", 2021. - 344 p.
 5. Permyakov O.A., Klochko O.O., Kamchatnaya-Stepanova O.V., Kovalev V.D., Vasylichenko Y.V., Sapon S.P. Modeling of technological processes of processing large-module gears. Comprehensive quality assurance of technological processes and systems (KZYATPS - 2021): materials of abstracts of reports of the XI International scientific and practical conference (Chernihiv, May 26–27, 2021): in 2 volumes / Chernihiv Polytechnic National University [etc.] ; resp. edited by Andriy Mykhailovych Eroshenko [and others]. - Chernihiv: Chernihiv Polytechnic University, 2021. - Vol. 1. - P. 73 – 74.
 6. .Shelkovy O.M. Automated design of group technological processes: educational and methodological manual / Shelkovy O.M. // – Kharkiv: NTU "KhPI", 2003. – 94p.
 7. Bezmenov, M. I. Introduction to Mathcad: educational method. manual for independent work from the course "Data Analysis" / M. I. Bezmenov, O. M. Bezmenova; NTU "KhPI". — Kharkiv: NTU "KhPI", 2019. — 68 p
- «Додаткова література»
1. DSTU GOST 7.1–2006. Bibliographic record. Bibliographic description. General requirements and drafting rules [Text]. – Instead of GOST 7.1–2003. – For the first time (with cancellation of GOST 7.1–84, GOST 7.16–79, GOST 7.18–79, GOST 7.34–81, GOST 7.40–82); enter 2007–07–01. - K.: Derzhspozhivstandard of Ukraine, 2007. - III, 47 p. – (System of information, library and publishing standards).
 2. Buchynskiy M.Ya., Horyk O.V., Chernyavskiy A.M., Yakhin S.V. FUNDAMENTALS OF MACHINE CREATION / [edited by O.V. Horyk, doctor of technical sciences, professor, honored worker of public education of Ukraine]. - Kharkiv: "NTMT" Publishing House, 2017. — 448 p. : 52 images ISBN 978-966-2989-39-7
 3. Hasanov M.I., Zakovorotny O.Yu., Shelkovy O.M., Klochko O.O., Permyakov E.O. Technological aspects of automated production in the system of designing control processes in mechanical engineering // Problems of informatics and modeling (PIM-2023). Abstracts of the twenty-third international scientific and technical conference. – Kharkiv: NTU "KhPI", 2023. – P. 3 – 4.
 4. Shelkovoy A.N., Hasanov M.I., Naboka E.V., Klochko A.A., Belousov N.A., Novikov F.V. Simulation modeling of the technological support of the operational properties of large-sized gears. New and unconventional technologies in resource and energy saving: Materials of the international scientific and technical conference, September 22-24, 2021, Odessa. - Odessa: State University "Odessa Polytechnic", 2021. - P. 207 - 210
 5. Rudenko P.O. Design of technological processes in mechanical engineering / P.O. Rudenko. - K.: Vyshcha Shk., 2003. - 420 p

Система оцінювання

Критерії оцінювання успішності студента та розподіл балів

100% of the final grade consists of assessment results in the form of an exam (40%) and current assessment (60%).
Current evaluation: 2 tests (12% and 10%) and an individual calculation task (10%), an active position when discussing issues at lectures and practical classes (5%), successful performance of practical work (10%), preparation of an individual illustrated report on given topic (3%).
Exam: written assignment (2 questions from theory + solution of a practical problem) and oral conversation

Шкала оцінювання

Сума балів	Національна оцінка	ECTS
90–100	Відмінно	A
82–89	Добре	B
75–81	Добре	C
64–74	Задовільно	D
60–63	Задовільно	E
35–59	Незадовільно (потрібне додаткове вивчення)	FX
1–34	Незадовільно (потрібне повторне вивчення)	F

Норми академічної етики і політика курсу

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": show discipline, education, benevolence, honesty, responsibility. Conflict situations should be openly discussed in study groups with the teacher, and if it is impossible to resolve the conflict, it should be brought to the attention of the employees of the institute's directorate.

Regulatory and legal support for the implementation of the principles of academic integrity of NTU "KhPI" is posted on the website: <http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/>

Погодження

Syllabus agreed



Завідувач кафедри
Oleksandr PERMYAKOV

Гарант ОП