



Syllabus Course Program

Metal-cutting Machines

**Specialty**

131 –
Applied Mechanics

Educational program

Applied Mechanics

Level of education

Bachelor's level

Semester

5

Institute

Institute of Education and Science in Mechanical Engineering and Transport

Department

Department of Mechanical Engineering Technology and Metal-Cutting Machines (146)

Course type

Free choice (professional), Selective

Language of instruction

English, Ukrainian

Lecturers and course developers

**Maryna Ivanova**

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Candidate of Technical Sciences. Associate Professor. Associate Professor of the Department of Mechanical Engineering Technology and Metal-Cutting Machines

Work experience - 12 years. Co-author of more than 50 scientific works, 1 monograph, and 2 training manuals. Leading lecturer in courses: Introduction to Speciality. Introductory Practice; Mechanization and automation of technological processes; Equipment and Transportation of Machining Shops, Technological Fundamentals of Machinebuilding.

[More about the lecturer on the department's website](#)

General information

Summary

The course "Metal Cutting Machines" provides knowledge about the main types of metal cutting equipment in modern machine and instrument engineering and the principles of designing new types of machine tools, as well as the regularities of forming the surfaces of parts during mechanical processing. In the course of training, students will learn how to develop a technical task for the design of metal-cutting equipment, work with standard graphic information processing packages.

Course objectives and goals

To form in students the ability to choose methods, determine calculations in the field of design, operation, technological support, development and use of metal cutting machines. Apply the acquired knowledge in practice when designing mechanisms and systems of machine tools. Develop control systems for mechanisms and machines. To form modern concepts and practical skills of analysis and synthesis of the design of machine tools, to substantiate the characteristics and designs of machine tools for various technological processes, which are necessary for a mechanical engineer in designing technological equipment and managing production processes during their creation.

Format of classes

There are lectures, practical classes, independent work, and consultations. The final control is an exam.

Competencies

GC03. Ability to abstract thinking, analysis, synthesis.

GC04. Ability to apply knowledge in practical situations.

GC05. Knowledge and understanding of the subject area and understanding of professional activity.

GC09. Ability to learn and master modern knowledge.

PC05. 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.

PC06. Ability to apply appropriate quantitative mathematical, scientific and technical methods, as well as computer software to solve engineering problems in applied mechanics.

PC07. Ability to describe and classify a wide range of technical objects and processes, based on in-depth knowledge and understanding of a wide range of mechanical theories and practices, as well as basic knowledge of related sciences.

PC08. The ability to acquire new knowledge and skills through independent study, using already acquired professional and general scientific knowledge and skills

PCc3.7 Ability to perform kinematic analysis of metal-cutting machines, draw up kinematic diagrams of mechanisms that perform basic and auxiliary movements for shaping the surfaces of parts by cutting, perform design calculations, design units and develop layouts of metal-cutting equipment

Learning outcomes

LO08. Evaluate the technological and technical and economic efficiency of new technical means;

LO09. Demonstrate knowledge and understanding of the principles of operation and design of mechanisms, technical parameters and characteristics of machines, practical skills in using application software for performing engineering calculations, processing information and experimental research results;

LO10. Demonstrate the ability to analyze specific kinematic diagrams of machine tools, justify the characteristics and designs of machine tools for various technological processes in the field of mechanical engineering;

LO17. Demonstrate knowledge and ability to use computer aided design (CAD), CAD and CAE systems;

PLO3.06 Know the technological equipment of machine-building industries.

PLO3.07 Know the basics of kinematic analysis of metal-cutting machines, methods of designing mechanisms, components and layout of metal-cutting equipment

Student workload

The total volume of the course is 180 hours (6 ECTS credits): lectures - 48 hours, practical training - 32 hours, self-study - 100 hours.

Course prerequisites

To successfully complete the course, you must have knowledge and practical skills in the following disciplines: "Interchangeability, Standardization and Technical Measurements", "Theoretical Mechanics", 'Machine Parts', 'Theory of Machines and Mechanisms'

Features of the course, teaching and learning methods, and technologies

Lectures are held in an interactive form using multimedia technologies. In practical classes, a project approach to learning is used, attention is focused on the independent solution of individual tasks.

Laboratory work is planned to be performed in the computer center of the department or university according to an individual task for each student. Study materials are available to students through the teacher's corporate disk.

Program of the course

Topics of the lectures

Topic 1. General basics of designing metal cutting machines

The subject and tasks of the discipline. Stages and stages of designing metal cutting machines.

Topic 2. Justification of the technical characteristics of metal cutting machines.

The composition and content of the characteristics of metal cutting machines. Determination of limit movements. Standard series of movement values. Determination of drive power.

Topic 3. Drives of metal cutting machines

Purpose and requirements for drives. Classification of drives. Design structure and sequence.

Topic 4. Kinematic calculation of main motion drives with a multiplicative structure.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters

Topic 5. Kinematic calculation of the drives of the main movement of milling machines.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters.

Topic 6. Kinematic calculation of the drives of the main movement of drilling machines.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters.

Topic 7. Kinematic calculation of the drives of the main movement with mechanisms of sorting.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters.

Topic 8. Kinematic calculation of main motion drives with reversing mechanisms.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters.

Topic 9. Kinematic calculation of main motion drives with variable gears.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters.

Topic 10. Kinematic calculation of main motion drives with connected mechanisms.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters

Topic 11. Kinematic calculation of main motion drives with connected mechanisms.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters

Topic 12. Kinematic calculation of main motion drives with stepless adjustment.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters

Topic 13. Features of the designs of the drives of the main movement of modern metal-cutting machines.

Drives of the main movement with discharge of speeds. Drives of the main movement with overlapping speeds. Main motion drives with multi-speed motor. Calculation features.

Topic 14. Feed drives of metal cutting machines.

Purpose and requirements for drives. Classification of drives. Design structure and sequence. Feed drive mechanisms.

Topic 15. Kinematic calculation of feed drives with rack transmission.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters.

Topic 16. Kinematic calculation of feed drives with helical transmission.

Determination of the main kinematic parameters of drives. Selection and analysis of the kinematic structure. Construction of a kinematic scheme. Calculation of transmission parameters.

Topic 17. Spindle assemblies of metal cutting machines.

Purpose and requirements for nodes. Designs of spindle assemblies. Choice of accuracy class. Calculations

Topic 18. Control systems of metal cutting machines.

Purpose and requirements for nodes. Designs of control systems. Selection of control nodes. Many lever systems. Selective systems.

Topic 19. Basic parts and guides of metal cutting machines.

Purpose and requirements for basic parts and guides. Directional slips and their calculation. Directional rolling and their calculation.

Topic 20. Life support systems of metal cutting machines.

Lubrication systems. Calculation and construction of lubrication systems.

Topic 21. Cooling systems.

Means of feeding ZOTS to the cutting zone. ZOTS cleaning systems.

Topic 22. Chip removal systems.

Designs of chip removal systems. Calculation of the chip removal system.

Topics of the workshops

Topic 1. Design analysis and kinematic setup of a lathe.

Topic 2. Design analysis and kinematic setup of a vertical drilling press.

Topic 3: Design analysis and kinematic adjustment of a horizontal milling machine.

Topic 4. Design analysis and kinematic adjustment of a gear shaping machine.

Topic 5. Design analysis and kinematic adjustment of a hobbing machine.

Topic 6. Design analysis and kinematic setup of a Turret lathe.

Topic 7. Design analysis and kinematic setup of an Automated lathe.

Topic 8. Design analysis and kinematic setup of a CNC lathe.

Topics of the laboratory classes

Laboratory work is not provided for in the educational program.

Self-study

The course involves the implementation of an individual calculation task on the design of the drive of the main movement of a universal machine. Practical classes require the completion of an individual task for the development of a technical task for automating the calculation task of mechanical engineering, which is drawn up in a written report. Laboratory work is performed on a personal computer, the results are provided in the form of separate files. Students are also recommended additional materials (videos, articles) for independent study and analysis.

Course materials and recommended reading

References

1. Youssef, Helmi A. Machining technology : machine tools and operations / Helmi A. Youssef, Hassan El-Hofy. 2008.
2. P H Joshi. Machine tool handbook: Design and operation. 2007.
3. Rex Miller, Mark Richard Miller. Machine Shop Tools and operations. 5th Edition. 2004

Assessment and grading

Criteria for assessment of student performance, and the final score structure

100 points of the final grade consist of assessment results in the form of a credit (20 points) and the ongoing assessment (80 points).

Ongoing assessment:

1. Activity in the class (participation in discussions, answers to the teacher's questions) - 14 points.
2. Current control (3 tests of 10 points each) - 30 points.
3. Completion of tasks in practical classes - 16 points.
4. Completion of an individual task - 20 points.

Exam: oral answer to 3 questions (2 questions from theories + solving a practical problem).

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.

Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: <http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/>

Approval

Approved by

Date, signature

Head of the department
Oleksandr PERMYAKOV

Date, signature

Guarantor of the educational
program
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