Syllabus
Course Program

Equipment and Transport of Machining Shops

Specialty
131 –
Applied Mechanics

Institute
Institute of Education and Science in Mechanical Engineering and Transport

Educational program
Applied Mechanics

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

Level of education
Bachelor's level

Course type
Free choice (professional), Selective

Semester
5

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 "Equipment and Transport of Machine Tool Shops" provides knowledge of the main types of metal-cutting equipment and product handling equipment used in machine-building enterprises. The course covers different types of machine tools, their purpose, principles of operation, design features, and equipment control. During the course of their studies, students get to know various mechanisms and learn to understand the structural and kinematic diagrams of equipment and machine tools.

Course objectives and goals

To provide students with systematic knowledge of metal-cutting machines and means of moving products in machine shops of machine-building industries, to develop students' theoretical understanding of the trends in the development and modernization of modern equipment, to teach them to justify the choice of metal-cutting equipment and vehicles in the design of machine shops.

Format of classes

Lectures, laboratory classes, practical training, self-study, consultations. The final control is an exam.

Competencies

GC01 Ability to think abstractly, analyze and synthesize;
GC02 Knowledge and understanding of the subject area and understanding of professional activities;
GC03 Ability to identify, formulate and solve problems to solve problems;
GC07 Ability to learn and master modern knowledge;
GC12 Ability to search, process and analyze information from various sources;
PCs3.2 Ability to use information technology in engineering activities;
PCs3.5 Ability to provide skills in working with automated design systems of various geometric objects and mechanisms that are used in the in the technological sphere.;
PCs3.6 Ability to select the necessary technological equipment for mechanical engineering industries, to justify and determine appropriate transport and storage systems sites and workshops.;
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;
PCc3.8 Ability to select the type of technological equipment, carry out design and development work and organize its production.

Learning outcomes

LO06 Create and theoretically substantiate the design of machines, mechanisms and their elements based on methods of applied mechanics, general design principles, the theory of interchangeability, standard methods of calculating machine parts;
LO07 Apply normative and reference data to control
technical documentation, products and technologies to standards, specifications and other regulatory documents;
PLO3.06 Know the technological equipment of mechanical engineering industries;
PLO3.07 Know the basics of kinematic analysis of metal-cutting machines, methods of designing mechanisms, components and layout of metal-cutting equipment;
PLO3.08 Know the features of design and use of technological equipment for machining processes and equipment.

Student workload

The total volume of the course is 150 hours (5 ECTS credits): lectures - 48 hours, laboratory classes - 16 hours, practical training - 16 hours, self-study - 70 hours.

Course prerequisites

To successfully pass the course, it's required to have knowledge and practical skills in the following courses: "Introduction to the speciality", " Descriptive Geometry, Engineering and Computer Graphics". "Theoretical Mechanics", "Theory of Mechanisms and Machines", " Fundamentals of Theory of Materials Cutting and Cutting Tools ", " Mechanization and Automation of Technological Processes".

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, and the use of video materials on methods of processing parts in mechanical engineering. Laboratory classes are planned to be performed in the laboratory of the department according to an individual assignment for a group of students. Study materials are available to students through the teacher's corporate disk.

Program of the course

Topics of the lectures

Topic 1. The main types of mechanical engineering equipment.
Machine tools. Basic Motions in Machine Tools. Machine tool requisites: Machining Productivity, Accuracy and Surface Integrity, Product Design for Economical Machining, Environmental Impacts of Machining. Classification of machine tools.
Topic 2. Basic Elements of Machine Tools

Machine Tool Structures. Machine Tool Guideways (Sliding Friction, Rolling Friction, Externally Pressurized). Machine Tool Spindles. Spindle Bearings. Machine Tool Drives (Stepped Speed Drives, Stepless Speed Drives).

Topic 3. Basic Mechanisms of Machine Tools

Belt drives. Chain drives. Pick-Off Gears. Gearboxes. Planetary Transmission. Reversing Mechanisms. Couplings and Brakes. Reciprocating Mechanisms. Quick-Return Mechanisms. Whitworth Mechanism. Hydraulic Reciprocating Mechanism.

Topic 4. General-Purpose Lathe Machines

The functions of the lathe and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 5. General-Purpose Drilling Machines

The functions of the Drilling Machines and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 6. General-Purpose Milling Machines

The functions of the Milling Machines and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 7. Shapers, Planers, and Slotters

The functions of the Shapers, Planers, and Slotters and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 8. Boring Machines

The functions of the Boring Machines and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 9. Broaching Machines

The functions of the Broaching Machines and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 10. General-Purpose Grinding Machines Microfinishing Machines

The functions of the Grinding and Microfinishing Machines and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 11. Gear Cutting Machines

The functions of the Gear Cutting Machines and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 12. Turret and Capstan Lathes

The functions of the Turret and Capstan Lathes and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 13. Automated Lathes

The functions of the Automated Lathes and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine.

Topic 14. CNC Machine Tools

The functions of the CNC Machine Tools and related operations. Varieties of designs. The main components and movements. Analysis and synthesis of kinematic structure. Kinematic diagram. Setting up the machine. Coordinate System. Machine Movements in Numerical Control Systems. Interpolation.

Topic 15. Hexapods

Historical Background. Hexapod Mechanism and Design Features. Hexapod Constructional Elements (Strut Assembly, Sphere Drive, Bifurcated Balls, Spindles, Articulated Head, Upper Platform, Control System). Hexapod Characteristics. Manufacturing Applications.

Topic 16. Material Transport Equipment and Storage Equipment

Industrial Trucks. Automated Guided Vehicles. Rail-Guided Vehicles. Conveyors. Cranes and Hoists. Analysis of Material Transport Systems. Conventional Storage Methods and Equipment. Automated Storage Systems: Fixed-Aisle Automated Storage/Retrieval Systems. Carousel Storage Systems.

Topics of the workshops

Topic 1. 3d modelling of the gear transmission.
Topic 2. 3d modelling of the belt transmission.
Topic 3. 3d modelling of the chain transmission.
Topic 4. Drawing up and analyzing kinematic diagrams of machine tools.
Topic 5. Calculation of kinematic chains of a lathe.
Topic 6. Calculation of kinematic chains of a drilling press.
Topic 7. Calculation of kinematic chains of a milling machine.
Topic 8. Calculation of kinematic chains of a hobbing machine.

Topics of the laboratory classes

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.

Self-study

Students' self-study is based on the educational literature, which allows them to work on theoretical and practical issues of the course. The course involves individual calculation and graphic task to develope of the technical composition of the machine tool for machining a given surface of workpiece. Consultations on issues related to this assignment or on theoretical issues of the discipline are held individually or for a group of students. Students are also recommended additional materials (videos, web-resources) 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

Description of the final score structure, course requirements, and necessary steps to earn points, especially paying attention to self-study and individual assignments.

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 Mykola PROKOPENKO