

**National University of Life and Environmental Sciences of Ukraine**

**Department of Material Technology and Material Science (MTMS)**



**"CONFIRMED"**

Dean of Design and  
Engineering Faculty

Zinoviy RUZHYLO

«    »    2023

**"APPROVED"**

at a meeting of the department MTMS

Protocol № 15 of "10"05 2023

Head of Department

Evgeny AFTANDILYANTS

**"REVIEWED"**

Program Coordinator

133 "Sectoral mechanical engineering"

Volodymyr BULGAKOV

**PROGRAM OF THE COURSE**

## **"Technology of machine building"**

Speciality 133 "Sectoral mechanical engineering"

Educational program Sectoral mechanical engineering

Faculty of Design and Engineering

Developer: Associate professor, PhD – Sviatoslav Gnyloskurenko

Kiev – 2023

## 1. Description of the discipline

### Technology of machine building (title)

The working curriculum of the discipline " Technology of machine building" is compiled in accordance with the typical program of the named discipline and contains the following main sections:

1. Fundamentals of technology engineering.
2. Fundamentals of technical valuation.
3. Design of technological processes of mechanical processing.
4. Devices for metalworking machine tools.
5. Typical technological processes of manufacturing parts
6. Fundamentals of technology of assembly processes.

Areas of knowledge, direction of training, speciality, education and qualification level		
Education and qualification level	Bachelor	
Education direction	13 «Mechanical engineering»	
Speciality	133 "Sectoral mechanical engineering"	
Specialization	-	
Discipline characterization		
Type	Obligatory	
Total number of hours	210	
Number of credits ECTS	7	
Number of thematic modules	6	
Form of control	<i>Test-IV, VI semesters/examination-V semester</i>	
Indicators of the discipline for daily and distance learning		
	daily learning	distance learning
Year of study (course)	2,3	
Semester	IV, V, VI	
Lectures	15/30/15 hours.	
Practical, seminar classes	-	
Laboratory lesson	15/30/15 hours.	
Independent study	30/30/30 hours.	
Individual work		
Number of weekly classroom hours for daily learning	4/2 hours.	

## 2. The purpose and objectives of the course

**Aim:** To give the necessary knowledge to the future engineer-designer for the successful selection of technological methods for obtaining and processing billets to ensure high quality products, material savings, high productivity.

**Objectives:** the study of technological methods of obtaining and processing of billets, their technical and economic characteristics, the study of the basic schemes of equipment, design of workshops of machine-building plants, issues of technological design of blanks, taking into account the methods of their obtaining, technological methods to improve the reliability of machines.

As a result of studying the discipline the student must

**know:**

- the main technological processes of making blanks and machine-building products;
- Fundamentals of designing technological processes of mechanical processing of parts;

- bases of technology of assembly processes;

- bases of design of shops of machine-building plants;

**be able:**

- to choose a rational way of mechanical processing of workpieces, equipment, cutting tools, to calculate and assign treatment regimes, that is, to choose the rational technology of manufacturing parts;

- use methods to control the accuracy of machining parts of machines.

### **Competencies of educational program:**

1) *Integral competence:* The ability to solve complex specialized tasks and solve practical problems in the field of mechanical engineering using the theories and methods of modern science based on a systems approach and taking into account the complexity and uncertainty of the operating conditions of technological systems.

2) *General competencies:*

GC1. The ability to think abstractly.

GC2. Ability to apply knowledge in practical situations.

GC5. Ability to generate new ideas (creativity).

GC7. Ability to communicate in a foreign language.

GC8. The ability to act socially responsibly and consciously.

GC10. Skills in using information and communication technologies.

GC12. The ability to realize one's rights and responsibilities as a member of society, to realize the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine.

GC13. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technologies, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle.

3) *Special (professional) competences of the specialty (SC):*

PC1. Ability to apply typical analytical methods and computer software tools for solving engineering problems of industrial mechanical engineering, effective quantitative methods of mathematics, physics, engineering sciences, as well as appropriate computer software for solving engineering problems of industrial mechanical engineering.

PC2. The ability to apply fundamental scientific facts, concepts, theories, principles to solve professional problems and practical problems of industrial mechanical engineering.

PC4. The ability to implement engineering developments in industrial mechanical engineering, taking into account technical, organizational, legal, economic and environmental aspects throughout the life cycle of the machine: from design, construction, operation, maintenance, diagnostics and disposal.

PC7. The ability to make effective decisions regarding the selection of construction materials, equipment, processes and to combine theory and practice to solve an engineering task.

PC8. The ability to realize creative and innovative potential in project development in the field of mechanical engineering.

PC9. The ability to carry out commercial and economic activities in the field of mechanical engineering.

PC10. The ability to develop plans and projects in the field of mechanical engineering under uncertain conditions, aimed at achieving the goal, taking into account existing limitations, to solve complex problems and practical problems of improving product quality and its control.

**Programmatic learning results**

LR2. Knowledge and understanding of mechanics and mechanical engineering and their development prospects.

LR3. To know and understand the systems of automatic management of objects and processes of industrial engineering, to have skills in their practical use.

LR4. Carry out engineering calculations to solve complex problems and practical problems in industrial mechanical engineering.

LR7. Prepare production and operate products using automatic life cycle support systems.

LR10. To understand the problems of labor protection and legal aspects of engineering activity in industrial mechanical engineering, the skills of forecasting the social and environmental consequences of the implementation of technical tasks.

LR11. Communicate freely with the engineering community orally and in writing in national and foreign languages.

LR12. Apply means of technical control to evaluate the parameters of objects and processes in industrial mechanical engineering.

**3. The program and structure of discipline for**

- full term of daily and distance learning of the second and third year students in 4-6 semesters 2023/2024 academic year

Title of thematic modules and themes	Hours, quantity													
	Daily learning							Distance learning						
	Weeks	Total	Including					Total	Including					
			1	p	lab	ind	i.s.		1	p	lab	ind	i.s.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
The thematic module 1. Basics, fundamentals of machine building.														

Theme 1. Basics, fundamentals of machine building	1-2	4	2				4						
Theme 2. Fabricability (processability index, manufacturability) of products design	3-4	4	2	-	2	-	4						
Theme 3. Fundamentals of locating (basing) parts, workpieces, products	5-6	4	2	-	2	-	4						
Theme 4. Accuracy of mechanical processing and methods of its providing	7-8	4	7	-	9	-	14						
Theme 5. Quality of surfaces of machine parts and methods of its providing	9-10	4	2	-	2	-	4						
Total for thematic module 1			15		15		30		2		4		30
<b>The thematic module 2. Fundamentals of technical valuation</b>													
Theme 1. Fundamentals of technical valuation			2		3		4						
Total for thematic module 2			2		3		4				1		4
<b>The thematic module 3. Design of technological processes of mechanical processing.</b>													
Theme 1. Design of technological processes of mechanical processing.			7		8		8						
Total for thematic module 3			7		8		8						
<b>The thematic module 4. Devices for metalworking machine tools</b>													
Theme 1.		2	8		8		10						

Devices for metalworking machine tools													
Total for thematic module 4	2		8		8		10						
The thematic module 5. Typical technological processes of manufacturing parts													
Theme 1. Machining, processing parts of "SHAFTS" class, type			4		4		4						
Theme 2. Machining, processing parts of "Sleeves" class, type			2		2		4						
Theme 3. Machining, processing parts of "Levers" class, type			4		4		4						
Theme 4. Machining, processing parts of "Discs" class, type			2		2		4						
Theme 5. Machining, processing parts of "Gears" class, type			4		4		4						
Theme 6. Machining, processing parts of "Body parts" class, type			4		4		4						

Theme 7. Manufacturing of working parts of agricultural machines		2		2		4						
Theme 8. Manufacturing of nonmetallic parts		2				2						
Total for thematic module 5		24		22		30						
<b>The thematic module 6. Fundamentals of technology of assembly processes</b>												
Theme 1. Fundamentals of technology of assembly processes		2		2		2						
Theme 2. Automatization of assembly works		2		2		2						
Theme 3. Painting, drying, coating of parts		1				2						
Theme 4. Advanced machine building technologies		1				2						
Total for thematic module 6		6		4		8		1		1		6
Total of hours		60		60		90		8		16		86

#### 4. Lecture themes

№	Theme title	Hour numbers
1	Introduction. Tasks of the discipline. Basics, fundamentals of machine building. Production, technological processes.	2

2	Fabricability (processability index, manufacturability) of products design	2
3	Fundamentals of locating (basing) parts, workpieces, products. Principles of combining and dividing bases.	2
4	Accuracy of mechanical processing and methods of its providing.	2
5	Influence of part deformation and workpiece shape on machining accuracy. Total processing error.	2
6	Statistical methods of research of accuracy at mechanical treatment. Mathematical laws of determination at distribution actual dimensions of the processed surfaces.	2
7	Fundamentals of the theory of dimensional chains. Basic concepts and definitions.	2
8	Quality of surfaces of machine parts and methods of its providing	2
9	Purpose and tasks of designing. Technological documentation. The concept of ESKD and ESTD.	2
10	Selection of equipment and facilities, accessories for a technological process.	2
11	Machine tool for the technological process of machining parts.	2
12	Mechanisms of machine tools.	2
13	Optimization of cutting modes.	2
14	Technical and economic indicators of the technological process.	
15	Machining, processing parts of "SHAFTS" class, type	
16	Machining, processing parts of "Sleeves" class, type	2
17	Machining, processing parts of "Levers" class, type	2
18	Machining, processing parts of "Discs" class, type	2
19	Machining, processing parts of " Gears " class, type	2
20	Machining, processing parts of "Body parts" class, type	2
21	Manufacturing of working parts of agricultural machines	2
22	Manufacturing of nonmetallic parts	2
23	Fundamentals of technology of assembly processes	
24	Automatization of assembly works	
25	Painting, drying, coating of parts	
26	Advanced machine building technologies	

## 5. Laboratory work themes

№	Theme title	Hour numbers
1	Determining the dependence of the surface turning error on the ratio of the dimensions of the part fixed in the chuck.	2
2	Investigation of the influence of temperature deformations of a lathe cutter on machining accuracy.	2
3	Investigation of the influence of the elements of the cutting mode on the roughness of the machined surface during turning.	2
4	Determination of the error of installation of the cutter on the size on a limb of the machine.	2
5	Determination of the dependence of temperature deformations of the spindle unit of the vertical - milling machine on the time of its	2



	operation and cooling.	
6	Determination of the stiffness of the lathe. Determination of rigidity of a vertical milling machine by the production method	2
7	Determination of axial error, fixing the workpiece in a three-cam chuck.	2
8	Methods of studying working time. Timing of work on machines	2
9	Introduction. The main stages of technological process design. Preliminary elaboration of design decisions.	2
10	Determining the accuracy of processing with different methods of fixing the workpiece. Determination of base error during milling.	2
11	Analysis of the manufacturability of the design of the part. Preliminary selection of production type. Release stroke.	2
12	Influence of product rigidity on vibration resistance of technological system.	2
13	Choice of cutting modes. Standardization of technological process.	2
14	Processing of profile surfaces on the grinder on the copier.	2
15	Choice of workpiece type. Basic requirements for blanks. Calculation of interoperative allowances for machining.	2
16	Technical control of details of a class "shafts"	2
17	Preliminary development of the technological route.	2
18	Technical control of body parts.	2
19	Determining the size of the closing link in the compensatory method of assembling assemblies and units.	2
20	Methods of designing tool settings.	2
21	Design of the installation and clamping device. Requirements for clamping mechanisms.	2
22	Calculation of the accuracy of the device and the clamping force of the workpiece.	2
23	Registration of technological documentation.	1

## 6. Test questions and test sets for determine of the level assimilation of knowledge by students.

1. Production (process) – is the ...
2. What are the methods of product manufacturing ?
3. What is the Single/job production ?
4. What are the Single/job production Characteristics ?
5. What is the Batch/Serial production ?
6. What are the batch production Characteristics ?
7. What is the Mass or flow production?
8. What are the Mass or flow production Characteristics ?
9. Technological process is ...
10. Technological process consists of ...
11. Working place (working position) is ...
12. What is Set ?
13. POSITION is ...
14. Transitions are ...

15. Service Transitions are ...
16. Move/Travel/Passages/Steps (stroke) are ...
17. Procedure is ...
18. Product is ...
19. Products can be ... (examples)
20. Part is ...
21. Assembly unit is ...
22. Complex is ...
23. Set (complete set)
24. The purpose of technological processes planning of machine part production is
25. Machine building products should match the requirements of: **1) ... 2).... 6) ...**
26. The main tasks of technological process planning of machining are
27. Technological processes are usually developed when :
28. When planning new enterprise Technological process is the main basis for:
29. Data of the Technological process are used for
30. General requirements for development of technological processes are : 1)...9)
31. Technical and economical information used for development of technological processes are : 1) ....7)
32. Typical order of development of technological processes of the machining (mechanical operation, treatment) of part, component includes ( 1)...13) )
33. Classification of part classes to be produced by typical technological processes includes:
34. What are the main/basic principles of machine building ?
35. What are the stages of studying technological process
36. Typification results in ...
37. What are the classes of typical parts
38. What are the main/basic principles of machine building
39. Definition of parts “Shafts”
40. Definition of rigid and not rigid shafts.
41. What are the basic elements of shafts (groups).
42. What are the basic elements of shafts typical for this class.
43. What are the basic elements of shafts not typical for this class.
44. Technological processing of shaft is divided into two parts:
45. 3-4th class of accuracy of shafts intended for planting/attaching ... (list parts attached for such surface of shaft)
46. 2<sup>nd</sup> class of accuracy of shafts intended for planting/attaching ... (list parts attached for such surface of shaft)
47. What is the roughness of the contacting surfaces of shafts
48. What is the roughness of the not contacting surfaces of shafts
49. From which material shafts are made
50. What is the thermal treatment for shafts
51. Type of workpieces used to manufacture the shaft depends on
52. Which characteristics of shafts determine type of workpieces used to manufacture the shaft

53. What kind of workpieces are used for long stepped shafts and which equipment is used for their cutting
54. What operations are used for making short shafts with large difference in diameters
55. What processing steps are used in a typical route processing details of a class "shaft"
56. What additional operations can be introduced depending on the design features of the shaft and the technical requirements
57. What is the main technological base in the manufacture of shafts
58. What operations are used for pretreatment shafts billets/workpieces
59. What equipment is used for pretreatment shafts billets/workpieces in serial and mass production
60. What equipment is used for pretreatment shafts billets/workpieces in single and small-scale production
61. What structural elements are made on shafts for installation and mounting gears, sprockets etc.
62. Making structural elements on shafts such as gloss, grooves, slots and grooves are provided with equipment ... (list of equipment)
63. Two main types of the holes produced on the shafts are ...
64. Equipment for drilling operations of the holes and accuracy class and roughness of the holes.
65. Making thread (outer and inner) in the technological route of shaft processing depends on ...
66. What are the accuracy class and roughness of the thread
67. In small-scale, mass production cutting thread executed with ... (machines)
68. In large-scale production threading runs as a separate operation by ... (machines)
69. In mass production thread ... (machines) are used
70. Technique of making surfaces for slot, spline on the shafts depends on ...
71. What is the sequence of manufacturing operations of making surfaces for slot, spline on the shafts
72. What does the technical control of finished shafts includes :

## **7. Education methods.**

### 1) Verbal:

-Lectures;

### 2) Visual:

-Slides, video, visual material (parts, charts, stands).

### 3) Practical:

- Laboratory works;

- Training and factory practices;

- Project work

- Independent work.

## 8. Forms control.

- control work;
- module control work;
- test;
- examination.

9. **Distribution points that receive students.** The student evaluation is done in accordance with the provision «Про екзамени та заліки у НУБіП України» on 26.04.2023 p. Protocol № 10 and shown in Table 1.

### EVALUATION POLICY

<b>Deadline and retake policy:</b>	The student must submit the work within the time specified by the teacher. Works that are submitted in violation of deadlines without good reason are evaluated at a lower grade. Rearrangement of modules takes place with the permission of the lecturer if there are good reasons (for example, hospital).
<b>Academic Integrity Policy:</b>	Write-offs during tests and exams are prohibited (including the use of mobile devices). Course papers, abstracts must have correct text references to the literature used
<b>Visiting policy:</b>	The student is obliged to attend classes of all kinds every day in accordance with the established schedule, not to be late, to have the appropriate appearance. For objective reasons (for example, illness, international internship) training can take place individually (in online form in consultation with the dean of the faculty)

### STUDENTS GRADING SCALE

Rating of student, points	Marks accordingly National system for passing examinations, tests	
	Examinations	Tests
90-100	excellent	accepted
74-89	good	
60-73	satisfactory (passed)	
0-59	not satisfactory (not passed)	not accepted

The student rating of the discipline  $R_{\text{ДИС}}$  (up to 100 points) is determined as sum rating received at attestation  $R_{\text{АТ}}$  (up to 30 points) and the student rating for educational work  $R_{\text{НР}}$  (up to 70 points):

$$R_{\text{ДИС}} = R_{\text{НР}} + R_{\text{АТ}} .$$

## 10. Methodical provision

- Textbooks and manuals;
- Guidelines for laboratory works;
- Stands, posters;
- Equipment and various device.

## 11. Printed literature and Internet sources

### – Main:

1. Матеріалознавство і технологія конструкційних матеріалів: підруч. для вищ. навч. закл. України / А.С. Опальчук, Є.Г. Афтандіянц, Л.Л. Роговський, О.Є. Семеновський [та ін.]. – Вид. 2-ге, перероб. і допов. – Ніжин: Лисенко М.М., 2013. – 751 с.
2. Основні поняття і принципи технології машинобудування. Методичні вказівки з дисципліни "Технологія машинобудування" для студентів спеціальності (освітня програма) 133 «Галузеве машинобудування». К, НУБіП України. Укл. Семеновський О.Є., Похиленко Г.М.
3. Технологія сільськогосподарського машинобудування: підруч. для вищ. техн. закл. України / Б. М. Гевко [та ін.]. – Вид. 2-ге, перероб. і допов. – Тернопіль : Паляниця В. А., 2015. – 418 с.– ISBN 978-617-7331-10-9.
4. Технологія машинобудування. Проектування та виробництво заготовок [Текст] : підручник для студ. машинобуд. спец. вищ. навч. закладів / Л. І. Боженко. – Львів : Світ, 1996. – 368 с. – ISBN 5-7773-0319-6.
5. Технологічні процеси отримання заготовок для сільськогосподарського машинобудування. Методичні вказівки з дисципліни "Технологія машинобудування" для студентів спеціальності (освітня програма) 133 «Галузеве машинобудування». – К., НУБіП України. Укл. Семеновський О.Є., Похиленко Г.М.
6. Технологія машинобудування. посібник для студ. машинобуд. спец. вищ. навч. закладів / Є.О. Горбатюк, М.П.Мазур та ін. – Львів: Новий Світ, 2009. – 358 с. РОЗМІРНІ ЛАНЦЮГИ Навчально-методичний посібник. Ю.Є. Паливода, А.Є. Дячун, Ю.Б. Капаціла, І.Г. Ткаченко. - Тернопіль : Тернопільський національний технічний університет імені Івана Пулюя, 2018. – 132 с.

### – Additional:

1. Медвідь М.В., Шабайкович В.А. Теоретичні основи технології машинобудування. За ред. проф. М.В. Медвідя. Львів: Видавниче об'єднання «Вища школа», 1976. – 299 с.

2. Боровик А.І., Лінчевський П.А., Петраков Ю. В. Технологія машинобудування. Підручник.: ЖДТУ, Житомир. – 2005, 835 с.
3. Сучасні методи аналізу технологічних процесів у машинобудуванні: Навч. посібник /В.В. Душинський. – К.: ІСДО, 1994. – 216 с.
4. Технологія обробки на верстатах з ЧПК [Текст] : навч. посіб. для студ. машинобуд. спец. вищ. техн. навч. закл. / Гевко Б. М. [та ін.] ; Терноп. нац. техн. ун-т ім. Івана Пулюя, Каф. технології машинобуд. та автомобілів. – Т. : Крок, 2014. – 131 с. : табл., рис. – Бібліогр.: с. 126-128. - 300 экз. – ISBN 978-617-692-168-4.
5. Методические указания к расчету припусков (расчетно- аналитический метод) по дисциплине "Технология машиностроения" для студентов специальностей 12.01 и 12.02 всех форм обучения / Сост. В.В. Душинский, В.Г. Беланенко, А.П. Кругляк и др. – К.: КПИ, 1991. – 80 с.

**– Internet sources:**

1. Технологія машинобудування. Посібник-довідник для виконання кваліфікаційних робіт. – <http://vlp.com.ua/node/3850>
2. Машинобудування України: тенденції розвитку Бібліографічний список літератури. – [http://library.zntu.edu.ua/bibliograf\\_pokaz/mashinobud.pdf](http://library.zntu.edu.ua/bibliograf_pokaz/mashinobud.pdf)
3. Технологія машинобудування Є.О. Горбатюк, М.П. Мазур, А.С. Зенкін, В.Д. Каразей. – <http://www.tnu.in.ua/study/refs/d184/file1357975.html>
4. Нові технології виробництва ракет у КБ «Південне». – <https://www.ukrmilitary.com/2018/12/new-technology-on-kb-pivdenne.html>
5. The complete guide to machined parts. – <https://www.3erp.com/blog/the-complete-guide-to-machined-parts/>
6. Is Hybrid Manufacturing Technology the Future of Additive Manufacturing? – <https://amfg.ai/2018/07/10/hybrid-technology-the-future-of-manufacturing/>
7. Технологія машинобудування. Посібник-довідник для виконання кваліфікаційних робіт. Юрчишин І.І. та ін. – <http://www.tnu.in.ua/study/refs/d184/file1357977.html>