The National University of Life and Environmental Sciences of Ukraine

Faculty of Design and Engineering

Department of Material Technology and Material Science (MTMS)

APPROVE:
Dean of Design and
Engineering Faculty

Ruzhylo Z. V.
«__» _____ 2020

REVIEWED AND CONSIDERED
at a meeting of the MTMS department

Protocol № 16 of "19" 05 2020
Chief of Department
Ye. Aftandiliants

WORK PROGRAM OF THE EDUCATIONAL DISCIPLINE

"Technology of machine building"

Knowledge area 13 "Mechanical engineering "
Speciality 133 "Sectoral mechanical engineering"
Faculty of Design and Engineering

Developer: Gnyloskurenko S., Associate professor, Ph.D.

Kiev – 2020

1. Description of the discipline

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.
7. Basis of designing workshops of agricultural machine-building plants.

Technology of machine building
(title)

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	315	
Number of credits ECTS	8	
Number of thematic modules	6	
Form of control	*test/examination*	
Indicators of the discipline for daily and distance learning		
	daily learning	distance learning
Year of study (course)	2,3,4	
Semester	2	
Lectures	*60/35* hours.	
Practical, seminar classes	-	
Laboratory lesson	*150/75* hours.	
Independent study	*45/90* hours.	
Individual work	*90*- hours.	
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.

acquisition of competencies:

general competencies (GC):

The discipline lays the knowledge base for students for further study of a number of professional disciplines of technical and technological direction.

3. The program and structure of discipline for

- full term of daily and distance learning

Title of thematic modules and themes	Hour numbers												
	Daily learning							Distance learning					
	Weeks	Total	Including					Total	Including				
			l	p	lab	ind	i.s.		l	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. The theory of alloys	1-2	8	4	-	4	-	2	22	2	-	-	-	20
Theme 2. Carbon steels and cast irons	3-5	12	6	-	6	-	3	22	-	-	2	-	20
Total for thematic module	25		10	-	10	-	5	44	2	-	2	-	40

1													
The thematic module 2. Bases of heat treatment of metals and alloys													
Theme 1. The theory of heat treatment	6-8	12	6	-	6	-	2	22	2	-	-	-	20
Theme 2. Technology of heat treatment	9-11	12	6	-	6	-	3	22	-	-	2	-	20
Total for thematic module 2	29		12	-	12	-	5	44	2	-	2	-	40
The thematic module 3. Alloyed steels and alloys													
Theme 1. The alloying theory	12-13	8	4	-	4	-	2	22	2	-	-	-	20
Theme 2. Classification of alloy steels, marking and their use in agriculture	14-15	8	4	-	4	-	3	22	-	-	2	-	20
Total for thematic module 3	21		8	-	8	-	5	44	2	-	2	-	40
The thematic module 4. Steels and alloys with special properties													
Theme 1. Corrosion and heat resistant steels and magnetic alloys.	1-2	4	2	-	2	-	2	20	-	-	-	-	20
Theme 2. Amorphous, bimetallic and composite materials and materials with shape memory	3-5	4	2	-	2	-	3	20	-	-	-	-	20
Total for thematic module 4	13		4	-	4	-	5	40	-	-	-	-	40
The thematic module 5. Non-ferrous metals and alloys													
Theme 1. Copper, aluminum, titanium,	6-8	8	4	-	4	-	2	20	-	-	-	-	20

magnesium and their alloys													
Theme 2. Zinc, lead. Solders. Antifriction alloys	9-11	6	3	-	3	-	3	20	-	-	2	-	20
Total for thematic module 5	19		7	-	7	-	5	40	-	-	2	-	40
The thematic module 6. Nonmetallic construction materials													
Theme 1. Polymers and plastics. Rubber. Glue materials. Inorganic glass.	12-13	4	2	-	2	-	2	16	-	-	-	-	16
Theme 2. Paints and insulating materials. Wood.	14-15	4	2	-	2	-	2	16	-	-	-	-	16
Total for thematic module 6	12		4	-	4	-	4	40	-	-	-	-	40
Total of hours	119		45	-	45	-	29	246	6	-	8	-	232

4. Lecture themes

№	Theme title	Hour numbers
3 semester		
1	The purpose and objectives of the course. (Classification. Atomic crystal structure of metals. Defects in the crystal structure of metals).	2
2	Phase transformations of metals and alloys. (The concept of alloy crystallization and modification. The temperature crystallization. The phenomenon of supercooling. The concept of anisotropy. Allotropic transformation).	2
3	Basic theory of alloys. (Definition of "Alloy", "Component", "Phase". “Solid solutions”. Regularities of cooling metals and alloys).	2
4	State diagrams of binary alloys. (Main types of phase diagrams of two-component alloys. Determination of the phase diagram of alloys. The conditions building. State diagrams alloys of the type I. State diagrams alloys of the type II. State diagrams alloys of the type III. State diagrams alloys of the type IV. Kournakov rule. Section rule.)	2
5	Diagram of the iron - cementite alloys.	2

	(Temperature curve heating and cooling of pure iron. Identification of all lines of iron - cementite diagram. Characteristics of structural components of iron-carbon alloys. Definitions of "eutectic" and " eutectoid")	
6	Carbon steels. Classification and application. (Structure hypoeutectoid, eutectoid and hypereutectoid steels. Labelling and application of carbon steels).	2
7	Cast irons, classification, application. (Concept and classification of cast irons. The impurity influence on the structure and properties of cast irons. Method, structure, labeling and application of gray, ductile and high strength irons.)	2
8	Theory of heat treatment. (Transformation of pearlite - carbide structure in austenite during heating. Temperature influence on the grain size of austenite during heating. The concept of inheritance structure. The influence of grain size on the properties of steel. Methods for determining grain size).	2
9	The basic structure and transformation during heat treatment of steels. (Pearlitic transformation. The mechanical properties of steels with structures of perlite, sorbite, troostite (fine pearlite). Martensitic transformation. The nature of the mechanism and kinetics of transformation. Martensite properties. The Martensite transformation at heating.)	2
10	Diagram of austenite isothermal disintegration. (General characteristics of austenite transformation at supercooling. Construction diagram of isothermal transformation of austenite to 0.8% carbon steel. The transformation of austenite under continuous cooling.)	2
11	The heat treatment technology of carbon steels. (Annealing, normalization, quenching, tempering and aging of steels).	2
12	Chemical heat treatment of steels. (Basic processes occurring at the chemical and heat treatment. cementation, nitriding)	2
13	Bases alloying steels. (The influence of alloying elements on the properties of steel. Features heat treatment of alloyed steels. Isothermal transformation of austenite in alloy steels. The influence of temperature on the properties of quenching steel alloy).	2
14	Classification and labeling of alloy steels. (Determination of class alloyed steel. Labelling structural and tool alloy steel).	
15	Constructional alloyed steels. Spring and ball bearing steels. Tool alloyed steels.	
4 semester		
1	Steels and alloys with special properties. (High-strength and wear-resistant steel. Corrosion-resistant and heat-	2

	resistant steel. Magnetic steel and alloys. Alloys with high electrical resistance. Steels with a given temperature coefficient of linear expansion).	
2	Foreign labeling of alloy steels	2
3	Copper, aluminum and their alloys	2
4	Titanium, magnesium and their alloys. Bearing alloys	2
5	Amorphous materials and materials with shape memory	2
6	Composite and bimetallic materials	2
7	Polymers and plastics. Rubber. Glue materials. Inorganic glass.	2
8	Paints and insulating materials. Wood.	1

5. Laboratory work themes

№	Theme title	Hour numbers
3 semester		
1	Macrostructural analysis of metals and alloys	2
2	Microstructural analysis of metals and alloys.	2
3	The study diagrams of binary alloys	2
4	The thermal method of analysis of metals and alloys. Construction of diagrams of tin-zinc alloys.	2
5	The analysis of state diagram of iron-carbon alloys	2
6	Study of the microstructure of carbon steels at equilibrium state	2
7	Study of microstructure of cast irons	2
8	Structural changes in the carbon steel at heating.	2
9	Annealing and normalization of carbon steels. Study of microstructure and hardness changes	2
10	Quenching of carbon steels	2
11	Tempering of quenching steels	2
12	Determination of critical temperatures of steels by method of test quenchings	2
13	Determination of carbon steel microstructure in a nonequilibrium state	2
14	Surface hardening steels by high frequency currents	2
15	Chemical heat treatment of steels	2
4 semester		
1	Definition hardenability steels	2
2	Study of microstructure of alloy steels	2
3	Development of technological process of the heat treatment of parts of agricultural machines	2
4	Study of the microstructure of copper alloys	2
5	Study of the microstructure of aluminum alloys	2
6	Study of microstructure babbits	2

7	Composite and bimetallic materials	2
8	Materials with shape memory	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^{nd} 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 (perts, charts, stands).
3) Practical:
   - Laboratory work;
   - Training and factory practices;
   - Independent work.

8. Forms control.

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

9. Distribution points that receive students. The student evaluation done in accordance with the provision «Про екзамени та заліки у НУБіП України» від 27.12.2020 р. протокол № 5 з табл. 1.

EVALUATION POLICY

Deadline and retake policy:	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).
Academic Integrity Policy:	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
Visiting policy:	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)

STUDENT EVALUATION SCALE

Student rating,	Evaluation results on national exam tests

points	Exams	tests
90-100	Excellent	Accepted
74-89	Good	
60-73	Satisfactory	
0-59	Unsatisfactorily	Not accepted

The student rating (listener) of the discipline $\mathbf{R_{ДИС}}$ (up to 100 points) to determine as sum rating received at attestation $\mathbf{R_{AT}}$ (up to 30 points) and the student (listener) rating for educational work $\mathbf{R_{HP}}$ (up to 70 points):

10. Methodical provision

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

11. Recommended Literature

- Main:

1. **– main:**

1. Textbook of advanced machine work. Barlow. Boston. 2006, 316 p.
2. Аунапу Ф. Ф. и др. Технология сельскохозяйственного машиностроения. – М.: Машиностроение, 1968.
3. Воробьев Л. Н. Технология машиностроения и ремонт машин. – М.: «Высшая школа», 1981.
4. Зуев А. А., Гуревич М. Е. и др. Технология сельскохозяйственного машиностроения. – М: Колос, 1980.
5. Егоров М.Е. и др. Технология машиностроения. – М: Высшая школа, 1976.

– – ancillary:

1. Корсаков В.С. Основы конструирования приспособлений в машиностроении. – М., Машиностроение, 1986;
2. Косилова А.Г., Мещеряков Р.К., Калинин М.А. Точность обработки, заготовка и припуски в машиностроении: Справочник. – М. Машиностроение, 1975.
3. Акимов В.Л. Технологические расчеты при проектировании процессов механической обработки заготовок. – Л.: ЛПИ, 1980.
4. Скраган В.А., Амосов И.С., Смирнов А.А. Лабораторные работы по технологии машиностроения. – Л.: Машиностроение, 1974.
5. Некрасов С.С., Гурьянов А. И. Лабораторные работы по курсу «Технология машиностроения». – М.: 1973.
6. Медвідь М. В., Шабайкович В. А. Теоретичні основи технології машинобудування. – Львів. “Вища школа”, 1976.
7. Ботенко Л. І. Технологія машинобудування. – К.: “Колос”, 1996.
8. Методичні вказівки до лабораторних робіт з дисципліни “ Технологія машинобудування”, 1998.

12. Information Resources

1. Reference book.
2. Atlases.
3. Internet library.
4. Magazines.