Ministry of Higher and Secondary Special Education of the Republic of Uzbekistan

Andijan Mashine-Building Institute

Registered:
№ 1203
2022 y "04" 08

"I approve"
Vice-Rector for Academic Affairs
_____ S.R. Aliyev

WORKING CURRICULUM
BY SUBJECT

FUNDAMENTALS OF AUTOMATION AND AUTOMATION OF PRODUCTION PROCESSES

Field of study: 320000 – Production technology

Direction of study: 5320200 – Mechanical engineering technology, equipment and automation machine-building industries

Total number of hours	**284 hours**	**6-term**	**7-term**
Including:	**136 hours**	**64 hours**	**72 hours**
Lectures	68 hours	32 hours	36 hours
Practical exercises	36 hours	16 hours	20 hours
Laboratory classes	32 hours	16 hours	16 hours
Independent classes	148 hours	60 hours	88 hours

Andijan-2022 y.

The working curriculum has been prepared in accordance with the curriculum of the discipline approved by the Ministry of Internal Affairs of August 17. 2019 and registered under No. BD-5320200-3.02

The working program of the discipline was approved by the Educational and Methodological Council of the Andijan Mashine – Building Institute in 2022 "__" _____ protocol "___"

The compiler:

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I. The role of discipline in higher professional education.

Fundamentals of automation and automation of production processes, the main scientific and technical problems and prospects for the development of the field of technology, objects, phenomena and processes, automated methods, methods of mathematical description of automatic control systems and their analysis and synthesis, complex automation of the production process is the subject of the discipline and serves as the basis for the development of special subjects.

In mechanical engineering, the design of the production process of product preparation between production sites, the provision of methods and means of automation, the justification of the technological process, the design of the product and device, as well as the requirements for automation tools, the provision of tools, planning and knowledge of methods of operational management of the production process in given values, the history of science and covers development trends, prospects and results of socio-economic transformations in our republic.

II. Goals and objectives of the discipline.

The purpose of teaching the discipline is to teach students of this direction the basic principles of automatic control and management of technical systems that form the basis of complex automation, criteria for evaluating economic efficiency, calculation of process control cycles, information about technical means, automation of production, automation of main and auxiliary equipment, technological equipment for teaching automation of loading and assembly processes, classification, the structure and composition of automatic control devices and automatic lines, the general control structure and functional technological schemes, systems and methods of integrated automatic production management, to ensure the level of knowledge, skills and abilities required by the educational standard.

The task of science is methods and means of complex automation of production processes, methods of increasing the productivity of technological machines, automation of loading and receiving and transport operations, elementary production process - the object of automation, production processes, their main characteristics, control, management, commissioning, and also consists in training and improving the operation of automatic systems in digital software methods and control systems, automation of assembly processes, modern technological processes, robotic complexes and adaptive automated productions.

III. The main theoretical part (lectures).

1- table

№	Lecture topics.	Watch
	6 - term	
1-module. The principle of operation of automatic control and the model of		

	the automatic system.	
1	**Introduction to the discipline of automation and the basics of automation of the production process.**	**2**
1.1	Basic concepts and definitions.	
1.2	The main functional blocks of the automatic control system (ACS).	
1.3	Block diagram.	
2	**The principles of automatic control and the model of the automatic system.**	**2**
2.1	Physical and mathematical modeling.	
2.2	Problems and directions of development of complex automation in mechanical engineering.	
	2-module. Classification of automatic control systems.	
3	**Classification of automatic control systems.**	**2**
3.1	Algorithmic classification of automated control systems and their management and functional tasks.	
3.2	Open, closed and combined systems.	
	3-module. Automation of loading and transportation operations using warehouses.	
4	**Automation of loading and transportation operations using warehouses.**	**2**
4.1	Universal and special warehouses used in machine-building enterprises. Warehouse systems.	
4.2	Periodically and continuously operating automated vehicles and their types.	
4.3	Methods and systems of automatic unloading of goods to warehouses.	
5.	**Statics of the automatic control system (ACS).**	**2**
5.1	The concept of the ACS transmission coefficient.	
5.2	The total transmission coefficients of the links of the serial, parallel and their reverse connection system.	
	4-module. Dynamic model of managed objects.	
6	**Dynamic model of managed objects.**	**2**
6.1	Динамические свойства регулируемых объектов.	
6.2	Linearization of nonlinear differential equations. Transfer function and methods of its definition.	
	5-module. Time characteristics of dynamic automated systems.	
7	**Time characteristics of dynamic automated systems.**	**2**
7.1	Transmission and impulse characteristics and the mathematical relationship between them	
7.2	Frequency characteristics of the ACS.	
7	**Time characteristics of dynamic automated systems.**	**2**

7.3	Forms of recording a complex frequency function.	
6-module. Dynamic model links.		
8	**Exemplary dynamic links, positional, integrating, differentiating and lagging links.**	**2**
8.1	An ideal amplifier, aperiodic links of the first and second order.	
8.2	An ideal amplifier, aperiodic links of the first and second order.	
8	**Exemplary dynamic links, positional, integrating, differentiating and lagging links.**	**2**
8.3	Circular links and their characteristics.	
9	**Integrating, differentiating and lagging links and their characteristics.**	**2**
9.1	Classification of ACS using combinations of exemplary dynamic links.	
7-module. Block diagram of the automatic control system.		
10	**Block diagram of the automatic control system.**	**2**
10.1	Transfer and frequency functions of open and closed loop systems.	
10.2	The characteristic equation of the ACS.	
8-module. Criteria for the priority of the automatic control system.		
11	**Criteria for the priority of the automatic control system.**	**2**
11.1	Mathematical and mechanical concepts of priority.	
11.2	Impulse characteristics of the ACS.	
11	**Criteria for the priority of the automatic control system.**	**2**
11.3	Priority criteria.	
11.4	Algebraic and frequency priority criteria of Raus Hurwitz and Mikhailov.	
12	**Priority is given to the frequency of Nyquist's sermon. Priority determination based on the logarithmic frequency response.**	**2**
12.1	Quantitative determination of the priority reserve by the area coefficient and amplifier.	
9-module. Typical and transient functions (characteristics) of automatic control systems.		
13	**Typical and transient functions (characteristics) of automatic control systems.**	**2**
13.1	Quality indicators. Reconfiguration.	
13.2	Setup time. The number of vibrations. The degree of extinction. Static and dynamic errors.	
13.3	Ways to view graphs of linear transients of ACS. Stabilization and correction of links and systems.	
Total:		**32**
7- term		
10-module. Automation of the production process.		

14	**Automation of the production process.**	**2**
14.1	General information about mechanization and automation of production processes.	
14.2	Problems and directions of development of complex automation in mechanical engineering.	
14.3	Basic concepts and terms.	
	11-module. Methods of automation of production processes.	
15	**Methods of automation of production processes.**	**2**
15.1	The main content of the theory of efficiency in mechanical engineering.	
15.2	Cyclic, technological and actual efficiency of technological machines.	
15.3	Basic concepts and terms.	
16	**The balance of efficiency of automated technological machines.**	**2**
16.1	Ways to improve the efficiency of automated production.	
16.2	The suitability of the product design to automated conditions.	
16.3	Two classes of technological processes.	
16.4	The main characteristics of the production process.	
	12-module. The object of automation of production processes.	
17	**The object of automation of production processes.**	**2**
17.1	The production process, the cycle of technological machines, the production process of elements, as well as automated control systems are automation objects.	
17.2	The production process, the cycle of technological machines, the production process of elements, as well as automated control systems are automation objects.	
17.3	The production process, the cycle of technological machines, the production process of elements, as well as automated control systems are automation objects.	
18	**The main characteristics of the production process.**	**2**
18.1	Productivity, adaptability, efficiency, automation level and production tact.	
18.2	Technological suitability of the product design for automation.	
18.3	Technical specification for ensuring the specified quality of production automation.	
	13-module. Automation systems of production processes.	
19	**Automatic control systems of production processes.**	**2**
19.1	Control, management, regulation.	
19.2	Numerically software-controlled (CNC) and adaptive automatic control systems, their efficiency and indicators.	
	14-module. Creation of an automated production process.	
20	**Creation of an automated production process.**	**2**

XI. Educational, methodological and informational support.

Basic literature:

1.Fundamentals of Metal Cutting and Machine Tools B.I.. Juneja 2013 y.

1.William D.Callister, Jr., David G.Rethwich. Materials science and engineering/ Wiley and Sons.UK,2014

2.Шишмаров В.Ю. Автомвтика. Изд. Центр "Академия" 2013

3.Основы автоматизации производственных процессов нефтгазового производства. Под. Редакцей М.Ю.Праховой, изд.центр "Академия" 2012.

4.Л.В.Перегудов, А.Н.Хашимов, И.К.Шалагуров, С.Л.Перегудов Автоматлаштирилган корхона станоклари. Дарслик "Ўзбекистон" 2001

5.Мамаджанов А.М., Шалагуров И.К., Бобоназаров Ў.К. ва бошқалар. Рақамли дастурда бошқариладиган дастгохларда металга ишлов бериш технологиясиўқув қўлланма, "Шарқ"-Тошкент: 2007.

6.Корсаков В.С. Основы конструировании приспособлений. Учебник. М., Машиностроение. 2005.

7.Справочник инструментальщика. Под.общ. Ред. И.А.Ординарцева-Л.Машиностроение, 2000г. стр.846

Additional literature:

1.Mirziyoyev Sh.M. Erkin va farovon, demokratik O'zbekiston davlatini birgalikda barpo etamiz. O'zbekiston Respublikasi Prezidentining lavozimiga kirishish tantanali marosimiga bag'ishlangan Oliy Majlis palatalarining qo'shma majlisidagi nutqi. -T.: "Uzbekiston" NMIU, 2016.-56 b.

2.Mirziyoyev Sh.M. Qonun ustuvorligi va inson manfaatlarini ta'minlash-yurt taraqqiyoti va xalq farovonligining garovi. O'zbekiston Respublikasi Konstitutsiyasi qabul qilinganining 24 yilligiga bag'ishlangan tantanali marosimdagi ma'ruza 2016 yil 7 dekabr. - T.: "Uzbekiston" NMIU, 2016.- 48 b.

3.Mirziyoyev Sh.M. Buyuk kelajagimizni mard va olijanob xalqimiz bilan birga quramiz. - T.: "O'zbekiston" NMIU, 2017. - 488 b.

4.O'zbekiston Respublkasini yanada rivojlantirish buyicha xarakatlar strategiyasi to'g'risida. - T.-2017 yil 7 fevral, PF-4947-sonli Farmoni.

5.Бобоназаров У.К. Управление техническими системами, конспект-лекции - ТашГТУ. Т.: 2001.

6.Босинзон М.А. Современные системы ЧПУ и их эксплуатация. изд.Центр «Академия».-М.:2008.192с

Internet sites:

1.www.gov.uz
2.www.lex.uz
3.http://мт2
4.http://мт2
5.www.satbask.ru
6.www.ziyonet.uz
7.www.bilim.uz

20.1	Automation of loading, fixing and extraction of products on technological equipment as a task of ensuring and designing dimensions, time delays and information exchange in the production process.	
20.2	Methods and technical means of orienting objects in space.	
15-module. Classification of boot devices.		
21	**Classification of boot devices.**	**2**
21.1	Classification of automatic loading devices by type, design device and operating cycle time.	
21.2	Bootable devices.	
21.3	Loading devices with a magazine, a hopper, a magazine-hopper (HLD), their types and elements.	
22	**The value of automatic loading of products into technological equipment.**	**2**
22.1	Classification of subjects by orientation complexity. Sorting. HLD performance.	
22.2	Automation with the help of robots, auto operators and warehouses performing loading and transport operations.	
22	**The importance of automatic loading of items into process boxes.**	**2**
22.3	Automation with the help of robots, auto operators and keepers performing loading and unloading operations.	
16-module. Automation of sorting and control of products.		
23	**Automation of sorting and control of products.**	**2**
23.1	Methods of automation of control, management, adjustment of product sizes.	
23	**Automation of sorting and control of products.**	**2**
23.2	Control before, after and during the cutting process.	
23.3	Active and passive control systems.	
24	**Classification of automatic sorting and control devices.**	**2**
24.1	Technological means of automatic sorting and control systems.	
24.2	The structure and location of control devices, the general control structure and functional and technological schemes, types of measuring and control converters.	
17-module. Control of technological equipment in a numerical program.		
25	**Control of technological equipment in a numerical program (CNC).**	**2**
25.1	Types of control systems in a numerical program. Feedback sensors.	
25.2	Encoding of information.	
25.3	Creating a numerical control program and writing to the program and reading in the CNC device.	
18-module. Automation of assembly processes.		

26	**Automation of assembly processes.**	**2**
26.1	Manufacturability of the design during automatic assembly.	
26.2	Automatic assembly lines.	
26	**Automation of assembly processes.**	**2**
26.3	Mechanization and automation of the assembly process.	
27	**Robotic complexes in the assembly process (RTCs.).**	**2**
27.1	Classification of industrial robots, control systems, procedures and target mechanisms.	
27.2	Types of robotic complexes are single–machine and multi-machine RTCs.	
19- module. Complex automation of serial production.		
28	**Complex automation of serial production.**	**2**
28.1	Flexible systems of technological equipment (GSTO), their structure and characteristics.	
28.2	Process control systems and their functions in flexible automated production.	
28.3	Systems of automatic transport, collection and supply of GSTO tools, as well as the use of computers in GSTO.	
Total:		**36**
General lecture		**68**

Lectures are held for a streaming academic group in an auditorium equipped with multimedia facilities.

IV. A typical list of practical works.

2- table

№	Topics of practical work.	Watch
6 - term		
1	Examples of drawing up functional, basic and structural schemes of an automatic control system.	**2**
2	Examples of the definition of general transfer functions, based on the transfer functions of closed and open loop systems.	**2**
3	Examples for determining the priorities of an automatic control system.	**2**
4	Examples for determining the quality indicators of transient characteristics.	**2**
5	Examples for the adjustment and stabilization of the automatic control system.	**2**
6	Calculation and adjustment of parameters of electromagnetic drives of vibration loading devices.	**2**
7	Automation of loading devices. Methods and means of product orientation.	**2**
8	Automation of loading and unloading using industrial robots.	**2**

	Final control The final type of control and assessment of the student's knowledge on this type of control is carried out by a professor who did not teach. The final test is conducted in the form of a "written work" and is based on a variant of a "written work" of 5 points. The final control is carried out in the form of "written work" in various ways. each option consists of 5 questions. The theoretical questions are based on the keywords and phrases of the subject and cover all the topics of the subject.	5	18-19 a week
	Written	5	

Table -7

Evaluation	Mark (%)
"5"	90 — 100
"4"	70 — 89,9
"3"	60 — 69,9
"2"	0 — 59,9

	Types of ratings	Max. mark	Time of the event
	Intermediate exam (accepted by the teacher's teacher). Intermediate control is carried out in 2 stages. At the first stage, the student who scored 10 points receives and defends individual assignments. At the second stage, students with 10 points are divided into small groups (the number of students in each group can be 5-7), each group is given separate tasks and defenses are accepted. Assignments will be distributed among students in 2-3 weeks.	5	16- a week
	The activity of the group, theoretical and practical coverage of the task, logical coherence of conclusions, the presence of creative thinking, knowledge of legal documents and compliance with other requirements are taken into account. The defense will be organized after the lesson according to the schedule approved by the head of the department.		

	Итого:	**16**
	7-семестр	
9	Automation of product processing. The cutting process as an object of automatic control and regulation.	**2**
10	Control and sorting of products automation.	**2**
11	Automatic control during the processing of parts. Direct and indirect methods of measuring parts.	**2**
12	Automation of the assembly process. Orientation of parts during automatic assembly.	**2**
13	Automatic lines. Their classification, structure and installation.	**2**
14	Wear of the cutting tool, examples for automatic control of temperature and power modes of elastic movement of the lathe caliper and processing modes.	**2**
15	Examples for an automatic control system for elastic movement of hole processing, deep drilling of small diameters, measurement of surface roughness of parts on grinding machines.	**2**
16	Complex automation of serial production. The structure and systems of robotic machines.	**2**
17	Complex automation of serial production. Robotic workshop, systems and their composition.	**2**
18	Complex automation of serial production. Robotic machine tool systems and their composition.	**2**
	Total:	**20**
	General practice:	**36**

Practical classes at leading enterprises and science of our Republic, intended for conducting in research institutes. Students will get acquainted with automated production equipment operating at enterprises, robotic complexes, CNC machines and equipment, as well as carry out static and dynamic calculation of adjustment systems and their elements. Automatic lines, automated control and assembly practical introduction to processes, production processes research and development of automation methods automated devices produce a number of technological calculations. Practical control of technological processes and learn how to coordinate them. To familiarize students with the devices used for the transportation and loading of the workpiece and familiarity with the mechanisms. Basic geometric parameters of nozzle devices calculation and parameter setting. Various surfaces of the tray-ramp wall and details calculation and correction of the distance between the surfaces. Calculation of parts to determine the diameter. Calculation of the performance of various HLD. Calculation of the patency of the HLD. To study automating the orientation of parts on loading devices.

V. Typical list of laboratory work.

3- table

№	Topics of laboratory work.	Watch
	6-term	
1	Investigation of static and dynamic characteristics of measuring transducers (sensors).	2
2	Analysis of the accuracy of the setting device in the automatic control system.	2
3	Checking the static characteristics of a tachogenerator with an angular velocity converter and determining the transmission coefficient.	2
4	Verification of the model of typical dynamic links, switching characteristics and determination of the transmission coefficient.	2
5	Investigation of the operating modes of the design of an adjustable DC electric drive and analysis of the description of motion.	2
6	Analysis of the patency of parts in linear trays of slopes.	2
7	Performance analysis of vibration loading devices.	2
8	To determine the accuracy of the orientation of the performance of the hopper-loading and orientation device.	2
	Total:	16
	7- term	
9	To investigate the relationship of the part speed to the oscillation amplitude "A", the coefficient of friction "f" and the oscillation frequency "λ" in vibration-loading devices.	2
10	Determination of the influence of various factors on the performance of vibration-loading devices, as well as its optimal setting.	2
11	Analysis of the construction of a cyclogram of the work of industrial robots.	2
12	Precision analysis of flexible production systems.	2
13	Analysis of the accuracy of robot characteristics.	2
14	Analysis of the functions of the system structure and functional devices of robotic complexes.	2
15	Familiarity with the main technological elements of automatic lines of various parts processing.	2
16	Familiarity with the main technological elements of automatic lines of various parts processing.	2
	Total:	16
	General Laboratory:	32

Laboratory work, students develop knowledge and skills on the production processes of automation, technical means, automatic control, adjustment of the device of systems and their elements, principles of operation of functional and

Evaluation criteria	***5 "Excellent"*** - - The student makes independent conclusions and decisions. - - Can think creatively. - - He is an independent observer. - - Can apply the acquired knowledge in practice. - - Understand knows, expresses, expounds the essence of the subject (topic) and has an idea of the subject (topic). ***4 "Good"*** - - The student conducts independent observations. - - Can apply the acquired knowledge in practice. - - Understands, knows, expresses, expounds the essence of the subject (topic) and has an idea about the subject (topic). ***3 "Satisfactory"*** - Students can apply their knowledge in practice. -Understands, knows, expresses, expounds the essence of the subject (topic) and has an idea about the subject (topic). **"Unsatisfactory"**
	When a student has not mastered the curriculum, does not understand the essence of the subject (topic) and has no idea about the subject (topic).

When preparing a student's independent work, taking into account the specifics of a particular topic, it is recommended to use the following forms:

- study chapters and topics of subjects in textbooks and manuals;
- mastering part of the lectures on handouts;
- work with automated training and control systems;
- work on sections or subjects of special literature;
- study of new techniques, equipment, processes and technologies;
- in-depth study of sections and topics related to the student's educational and research work;
- educational activities using active and problem-based teaching methods;
- distance (correspondence) training.

IX. There is no computational and graphic work on the discipline.

X. Organization of a rating system for monitoring and evaluating students' knowledge.

Monitoring and evaluation of students' knowledge in the field of natural sciences at the Andijan Mashine-Building Institute. Resolution of the Ministry of Justice of the Republic of Uzbekistan dated September 26 , 2018 No. 3069 dated August 9 , 2018 19-2018 The issue is based on the "Regulation on the system of control and assessment of students' knowledge in higher educational institutions", developed in accordance with the order of the Minister of Higher and Secondary Special Education of the Republic of Uzbekistan.

6- table

Assessment methods	Tests, written papers, oral questions, presentations.

circuit diagrams, configuration of these devices, as well as to know the design, principle of operation, tasks and schemes.

VI. Instructions and recommendations for the course project (work).

The main purpose of the course work is to develop students' ability to work independently, develop practical skills in applying the theoretical knowledge obtained, make technical decisions suitable for real production conditions, and develop skills in using modern techniques and technologies.

The topics of the course work are determined by the development of calculations for the design of automatic control systems for technological processes and equipment for specific production conditions that depend directly on the technological processes and facilities of manufacturing enterprises. Each student is given a personal assignment form with a number and options for completing the course work. The task sheet specifies the topic of the projected course work, the initial data for registration, the list of recommended basic, additional and special literature, the timing of the provision of graphic parts.

The proposed course work includes the following mandatory sections:

1. To study the principles of operation, constructive (structural) device, methods and elements of automatic control systems used in approximate technological processes and technological equipment, and on the basis of their analysis to develop a functional and constructive (basic) scheme of a new automatic control system;
2. Separation of the structure of the developed automatic control system into a number of elementary links and the choice of their transfer function;
3. Development of an algorithmic (structural) scheme of an automatic control system and determination of the overall transfer function of the system in relation to a given effect;
4. View the graph of the transition process of the automatic control system and determine the values of the system quality indicators according to the graph of the transition process. Comparison of control accuracy in static operation mode.

Course work is performed in computational and graphical computer programs. The graphic part of the course work is performed in A1 format and consists of 4 figures in 12 format.

The completed course work includes the following materials:

1. The explanation of the course work may consist of 25, 30 pages together with the assignment form;
2. Computational and graphical part: The designed automatic control system consists of functional, structural (principal), algorithmic (structural) schemes and a graph of the transient process.

VII. Suggested examples of topics for coursework:

4 - table

1	Development of an automated control system that stabilizes the dimensions of a part on a centerless grinding machine.
2	Development of an automated control system that stabilizes the measurement of parts on a lathe.
3	Development of an automated control system that stabilizes the measurement of parts on lathes.
4	Development of an automated control system that stabilizes measurements of parts on a milling machine.
5	Development of an automatic adjustment system that stabilizes the torque acting on the drill bit on a machine for deep drilling of small diameter holes.
6	Development of an automatic adjustment system that stabilizes the temperature of the heating module for drying sturgeon fish.
7	Development of an automated control system that stabilizes the dimensions of parts processed on lathes by temperature.
8	Development of an automated control system that stabilizes the dimensions of parts on a lathe.
9	Development of an automatic adjustment system that stabilizes the humidity of the molding mixture in the modules (devices) of mixture preparation.
10	Automated control system that stabilizes the main speed of movement of lathes depending on the change in cutting temperature.

VIII. Guidelines and recommendations for independent work.

5- table

№	Topics for independent work.	Watch
	6-term	
1.	Basic concepts and definitions, basic functional blocks of the automatic control system (ACS), block diagram.	**10**
2.	Physical and mathematical modeling. Problems and directions of development of complex automation in mechanical engineering.	**10**
3.	Algorithmic classification of automated control systems and their management and functional tasks. Open, closed and combined systems.	**10**
4.	Universal and special warehouses used in mechanical engineering enterprises. Warehouse systems. Periodically and continuously operating automated vehicles and their types. Methods and systems of automatic unloading of goods to warehouses.	**10**
5.	The concept of the SAR transmission coefficient. The total transmission coefficients of the links of the serial, parallel and their reverse connection system.	**10**
6.	Dynamic properties of regulated objects. Linearization of nonlinear differential equations. Transfer function and methods of	**10**

	its definition.	
	Total:	**60**
	7- term	
7.	Transmission and impulse characteristics and the mathematical relationship between them. Frequency characteristics of the ACS. Forms of recording a complex frequency function.	**10**
8.	An ideal amplifier, aperiodic links of the first and second order. Circular links and their characteristics.	**10**
9.	Classification of ACS using combinations of exemplary dynamic links.	**10**
10.	Transfer and frequency functions of open and closed loop systems. The characteristic equation of the ACS.	**10**
11.	Mathematical and mechanical concepts of priority. Pulse characteristics of ACS. Priority criteria. Algebraic and frequency priority criteria of Raus Hurwitz and Mikhailov.	**10**
12.	Quantitative determination of the priority reserve by the area coefficient and amplifier.	**10**
13.	Quality indicators. Reconfiguration. Setup time. The number of vibrations. The degree of extinction. Static and dynamic errors (errors). Ways to view graphs of linear transients of ACS. Stabilization and correction of links and systems.	**10**
14.	General information about mechanization and automation of production processes. Problems and directions of development of complex automation in mechanical engineering. Basic concepts and terms.	**10**
15.	The main content of the theory of efficiency in mechanical engineering. Cyclicity, technological and actual efficiency of technological machines. Out-of-cycle directions and their types.	**8**
	Total:	**88**
	Total hours:	**148**

Independent mastering of new knowledge, searching for necessary information and determining ways to find it, collecting information using the Internet and conducting scientific research, writing a scientific article (dissertation) using scientific sources within a scientific circle or independently) and preparing lectures deepen students' knowledge, develops their independent thinking and creative abilities. Assignments are checked and evaluated by the teacher who conducts practical classes, and by the teacher who conducts lectures and notes and assimilation of the topic at each lesson.

To organize independent work, a set of methodological guidelines and recommendations, case studies, situational issues will be developed. The practical task, the method of solving cases and tasks for independent work are determined in accordance with the topics of the lecture.