NJSC «K.I. Satbayev Kazakh National Research Technical University»
A. Burkitbaev Institute of Industrial Engineering

«Applied Mechanics and Engineering Graphics» department

CURRICULUM PROGRAM

« MECHANICAL ENGINEERING »

Bachelor of engineering and technology in mechanical engineering

Direction of training: 6B071 - Engineering and Engineering

Пroup of educational programs: B064 - Mechanics and Metalworking

On the basis of the specialty 5B071200 – Mechanical engineering of the expired specialty Classifier

1st edition
in accordance with 2018 the national standard of education of higher education

Almaty 2018

The program is drawn up and signed by the parties:

from K.I. Satbayev KazNRTU:
1. Head of the Department «Applied Mechanics and Engineering Graphics», prof. Kaltayev A.,

2. Director of the Institute of Industrial Engineering Omarbekov B.O.,

3. Chairman of the EMB of the Department Japayev S.,

From employers:
1. General Director of LLP «Institute of mechanics and machine science», prof. Tuleshov A.K.

From the partner University:
1. al-Farabi KazNU Department «Mechanics», head of the Department «Mechanics», prof. Ракишева З.Б.

Approved at the meeting of the Educational and Methodological Board of K.I. Satpayev Kazakh National Research Technical University, Protocol No. 3 dated 19.12.2018.

Qualification:
Level 6 of the National qualifications framework:
6B070 Engineering and Engineering (bachelor's degree)
6B071 Engineering mechanics

Professional competence:
- ability to apply fundamental interdisciplinary knowledge and skills in natural sciences and mechanics to solve a wide range of engineering problems;
- ability to work as designers in mechanical engineering, energy, transport, chemical production;
- ability to work with high-tech production, laboratory and research equipment;
- ability to modelling and research complex physical and mechanical processes and design mechanical systems;
- ability to develop new mechanisms, devices, including Autonomous mechanisms and robots.

Short description of the program

The educational program "**Engineering mechanics**" is aimed at preparing bachelors to solve a wide range of engineering problems based on fundamental physical and engineering principles using modern mathematical and computer methods. A broad systematic approach is used in preparation, when engineering decisions are made by graduates with a full understanding of the possibilities and limitations, advanced technologies used and their integration.

In the course of training, special attention is paid to mathematics, information technologies, the laws of physics and mechanics that underlie modern engineering design. The basic education obtained in these areas of knowledge will allow future specialists to easily integrate into the workflow of almost any industry sector, it is easy enough to master a wide range of new technologies.

Our graduates can choose different career paths. Some may go into industry directly as practicing engineers, while others may continue to study for a master's degree in mechanical engineering or applied Sciences. Many make a career in business or in public activities. The best graduates have studied or are studying for master's or doctoral degrees at KazNU, NU, Purdue University, Georgia Institute of Technology, National University of Singapore, University of Pittsburgh, Lorand University, University of Illinois and many other universities.

The curriculum of the educational program "**Engineering mechanics**" developed in accordance with the curricula of the best research and engineering universities such as *Massachusetts Institute of Technology – MIT, Stanford University, University of Cambridge, Georgia Institute of Technology, Pennsylvania State University, Tokyo University, National University of Singapore, Nanyang Technological University (Singapore) and others.*

Thus, the mission of the educational program "**Engineering mechanics**" is to provide the market with highly qualified specialists with fundamental knowledge in the fields of natural Sciences and engineering mechanics to work in the field of high-tech engineering.

In the first two courses (in the first 4-5 semesters), students have the opportunity to receive a fundamental basic education in mathematics (differential and integral calculus, algebra and geometry, differential equations), physics (molecular physics, electricity and magnetism, optics and atomic physics), mechanics (kinematics, statics and strength of materials, dynamics), chemistry, information and digital technologies (information and communication technologies, programming, MATLAB, numerical methods and solving engineering problems), Kazakh and English. These basic Sciences are the basis of any new technologies and allow students who have mastered them to easily master new technologies and retrain for other specialties.

At the senior courses, students study in depth special courses of mechanics and engineering (engineering thermodynamics, fluid and solid mechanics, heat and mass transfer, design of mechanisms and machines, design of mechanical systems) and gain skills in computer design of machine elements and structures, design of mechanisms and mechanical systems, modeling and research of various mechanical processes and phenomena, development and creation of robots and manipulators, operation of modern equipment controlled by computers. Primary attention is paid to the skills of developing computer models of various engineering problems, complex mechanical and thermal processes using modern information technology.

The purpose of the educational program "Engineering mechanics" is to prepare mechanical engineers:

a) who have fundamental knowledge in mathematics, physics, mechanics and information technologies and are able to use them to solve a wide range of engineering problems, including in mechanical engineering;

b) who have the skills to master and apply scientific methods for obtaining and researching materials, engineering analysis, design, staging and conducting scientific research;

c) who are able to model and study complex physical and mechanical processes and design mechanical and thermal systems, including thermodynamic and thermal processes in power plants, man-made and natural processes;

d) capable of working as designers in mechanical engineering, energy, transport, chemical production, including the design of boilers and power units, the design of water, oil and gas pipelines, thermal routes, chemical reactors and mass transfer devices;

e) capable of developing new mechanisms and devices, including autonomous mechanisms and robots, efficient converters and accumulators of renewable energy sources, etc.

Graduates who have received a bachelor of science degree in the educational program "**Engineering mechanics**" have the following opportunities:

- to work in all branches of industrial production as a mechanical engineer, engineer-technician, engineer-technologist in the field of mechanics; technical consultant in the fields of activity;
- to work as an engineering employee in design organizations, institutions, institutes, universities;
- to work as a research engineer in research institutes and laboratories;
- to join the master's program in engineering.

The bachelor's degree program "**Engineering mechanics**" is the first level of qualification of the three-level system of higher education, it lays the Foundation for subsequent master's programs, and then doctoral programs.

At all levels of training, teaching is conducted by highly qualified teaching staff,

many of them are graduates of universities in the United States, Europe, Russia and other countries.

The main objectives of the educational program "Engineering mechanics" in the training of mechanical engineers are:

1) provide knowledge and understanding of the scientific and mathematical principles underlying the various specializations in mechanical engineering;

2) teach to apply the acquired knowledge to the analysis of engineering systems, processes and methods related to various areas of engineering mechanics, including using modeling methods;

4) teach engineering systems design methodologies and the ability to apply them;

5) instill the ability to find the necessary literature, use databases and other sources of information;

6) teach to analyze, planning and conduct the necessary research, interpret the obtained data and draw conclusions;

7) teach to choose and use appropriate equipment, tools, and techniques;

8) instill the ability to work effectively both individually and as a team member;

9) show awareness in the field of project management and business, knowledge and understanding of the impact of risks and changing conditions;

10) be aware of the need and have the ability to independently learn and improve skills throughout life;

11) understand health, safety, legal aspects and responsibility for engineering activities, understand the impact of engineering solutions on the social context and the environment;

12) follow the code of professional ethics and standards of engineering practice.

Requirements for applicants

Description of mandatory standard requirements for admission: is carried out according to the statements of the applicant completed in full secondary and vocational education on a competitive basis in accordance with points certificate issued by results of uniform national testing with a minimum rating of not less than 65 points.

Special requirements for admission to the educational program, including for graduates of 12-year schools, colleges of applied bachelor's degree programs, etc.: the availability of subject-specific and intersubject competencies is ensured through the implementation of the requirements for General education and education in the basic and profile cycles of academic disciplines, socio-ethical, economic, organizational and managerial, professional competencies. The adjustment of subject-specific and interdisciplinary competencies is carried out in accordance with the findings of regular monitoring of the results of the development of educational programs.

Code	Type of competence	Description of the competence	Result of the competence	Responsible
GENERAL (Implies full training with possible additional depending on the level of knowledge)				
G1	Communicative ness	- Fluent monolingual oral, written and communication skills	Full 4-year training with a minimum of 240 academic credits (including 120 contact	Kazakh and Russian language
		- ability not to fluently communicate with a second language - Ability to use communicative communication in various situations - there are basics of academic writing in the native language - diagnostic test for the level of language	classroom academic credits) with a possible transfer of credits in the second language, where students have an advanced level. The language level is determined by passing a diagnostic test	Department , English language
Depa rtme nt G2	Mathematical literacy	- Basic mathematical thinking at the communication level – ability to solve situational problems based on the mathematical apparatus of algebra and the principles of mathematical analysis - diagnostic test for mathematical literacy in algebra	Complete 4-year training with a minimum of 240 academic credits (120 of them contact classroom academic credits). With a positive pass of the diagnostic test, the level of Mathematics 1, with a negative-the level of Algebra and the beginning of analysis	Department of mathematics
G3	Basic literacy in natural science disciplines	- basic understanding of the scientific picture of the world with an understanding of the essence of the basic laws of science - understanding basic hypotheses, laws, methods, drawing conclusions and evaluating errors	Complete 4-year training with a minimum of 240 academic credits (120 of them contact classroom academic credits). With a positive pass of the diagnostic test, the level of Physics 1, General chemistry, with a negative-the level of the Beginning of physics and Basic basics of chemistry	Of the Department in areas of natural Sciences
SPECIFIC (implies reduced training due to retargeting credits depending on the level of knowledge on competencies for graduates of 12-year schools, colleges, universities, including humanitarian and economic areas)				
S1	Communicative ness	- Fluent bilingual oral, written and communicative skills - ability of non-fluent communication with a third language - writing skills of various styles and genres - skills of deep understanding and interpretation of one's own	Full credit transfer by language (Kazakh and Russian)	Department of Kazakh and Russian language

		work of a certain level of complexity (essay) - basic aesthetic and theoretical literacy as a condition for full perception, interpretation of the original text		
S2	Mathematical literacy	- Special mathematical thinking using induction and deduction, generalization and concretization, analysis and synthesis, classification and systematization, abstraction and analogy - ability to formulate, justify and prove propositions - application of General mathematical concepts, formulas and extended spatial perception to mathematical problems full understanding of the basics of mathematical analysis	Transfer of credits in Mathematics (Calculus) I	Department of Mathematics
S3	Special literacy in natural science disciplines (Physics, Chemistry, Biology and Geography)	- Broad scientific perception of the world, which provides a deep understanding of natural phenomena - critical perception for understanding the scientific phenomena of the surrounding world - cognitive abilities to formulate a scientific understanding of the existence of matter, its interaction and manifestations in nature	Transfer of credits in Physics I, General chemistry, General biology, Introduction to Geology, Introduction to geodesy; educational practice, etc.	
S4	English	- readiness for further self-study in English in various fields of knowledge - readiness to gain experience in project and research work using English	Transfer of English language credits above the academic level to the professional level (up to 15 credits)	
S5	Computer skills	- Basic programming skills in one modern language - use of software and applications for teaching in various disciplines -availability of a worldwide standard certificate of language level	Credit transfer in the discipline Introduction to information and communication technologies, Information and communication technologies	

S6	Social and humanitarian competencies and behavior	-understanding and awareness of the responsibility of each citizen for the development of the country and the world - Ability to discuss ethical and moral aspects in society, culture and science	Credit transfer in the Modern history of Kazakhstan (except for the state exam)	Department of social disciplines
		-Critical understanding and ability to polemics for debating on modern scientific hypotheses and theories	Resetting credits in philosophy and other Humanities	
PROFESSIONAL (implies reduced training due to retargeting credits depending on the level of knowledge on competencies for graduates of colleges, secondary schools, universities, including humanitarian and economic areas)				
P1	Professional competencies	- critical perception and deep understanding of professional competencies at level 5 or 6 - Ability to discuss and polemize on professional issues within the framework of the mastered program	Transfer of credits in basic professional disciplines, including introduction to the specialty, structure and construction of systems and machines by industry, maintenance of machines by industry educational and training and production practice	Graduate Department
P2	General Engineering competencies	- basic General engineering skills and knowledge, ability to solve General engineering problems and problems - to be able to use application software packages for processing experimental data, solving systems of algebraic and differential equations	Credit transfer for general engineering disciplines (Engineering graphics, descriptive geometry, fundamentals of mechanics, fundamentals of hydrodynamics, fundamentals of electrical engineering, fundamentals of microelectronics, fundamentals of thermodynamics, fundamentals of geology, etc.)	Graduating Department
P3	Computer engineering competencies	- basic skills of using computer programs and soft systems to solve common engineering tasks	Credit transfer for the following computer graphics disciplines, CAD fundamentals, CAE fundamentals, etc.	Graduating Department
P4	Engineering and working competencies	- skills and abilities to use technical means and experimental devices to solve common engineering problems	Transfer of credits for academic disciplines of the experimental direction: turning and locksmithing, repair work, welding, laboratory or analytical chemistry, laboratory physics, mineralogy, etc.	Graduating Department
P5	Socio-economic competence	- Critical understanding and cognitive ability to reason on current social and economic issues - Basic understanding of the economic assessment of objects of study and the profitability of	Transfer of credits in socio-humanitarian and technical-economic disciplines to the credit of the elective cycle	Graduate Department

		projects in the industry		

The University may refuse to reschedule credits if a low diagnostic level is confirmed or if the final grades were lower than A and B in the completed disciplines.

Requirements for completing studies and obtaining a diploma

Description of mandatory standard requirements for graduating from a university and obtaining an academic bachelor's degree: mastering at least 240 academic credits of theoretical training and the final thesis

Special requirements for graduation from this program:

- implementation and protection of an interdisciplinary project in the field of study.
- the student should have a general understanding of the topic of the thesis, and contact potential research supervisors one year before the expected completion of the study;
- mandatory practical training on the topic of the thesis;
- upon completion of the internship, the student contacts the supervisor in writing or orally and reports on the results of the work, but not more than a week after the beginning of the 4th year of study;
- within 4 weeks after the start of the study, the student and the supervisor should discuss and decide on the type (research, project or independent study) and the topic of the thesis (this is an extremely important discussion and decision, since further changes in the topic and type of work are impossible);

4 Working curriculum of the educational program

Year of study	Code	Name of disciplines	Cycle	The total volume of	classroom the volume of LK/lab/PR	Код Transfer code	Pre-set transfer code
1	1st semester (fall 2019)						
	LNG 1051	Beginner (A1)	G	6	0/0/3/3	S4	Diagnostics.
	LNG 1052	Elementary English (A1)					
	LNG 1053	General English 1 (A2)					
	LNG 1054	General English 2 (A2)					
	LNG 1055	Academic English (B1)					
	LNG1056	Business English (B2)					
	LNG1012	General Kazakh (Russian) (A2)	G	4	0/0/2/4	S1	Diagnostics.
	LNG1012.1	Academic Kazakh (Russian) (B1)					
	LNG1012.2	Business Kazakh (Russian) l(B2)					
	MAT110	Algebra and intro to mathematical analysis	B	6	1/0/2/3	S2	Diagnostik.
	MAT101	Math I					
	PHY110	Intro to physics	B	6	1/1/1/3	S3	Diagnostics. Test
	PHY413	Physics I: Mechfnics. Molecular phisics and thermodynamics					
	GEN111	Engineering Graphics	B	6	1/1/1/3	no	no
	HUM113	Modern history of Kazakhstan	O	6	1/0/2/3	S6	no
	Sub Total:			34	17		
2	3rd semester (fall 2020)						
	LNG 1053	General English 1 (A2)	G	6	0/0/3/3	no	LNG 1052
	LNG 1054	General English 2 (A2)					LNG 1053
	LNG 1055	Academic English (B1)					LNG 1054
	LNG1056	Business English (B2)					LNG 1055
	LNG 1057	Professional English (B2+)					LNG1056
	MAT102	Maths II	B	6	2/1/0/3	no	MAT101
	CHE199	Physical Chemstry					CHE192
	CSE174	Information and communication technology	G	6	2/1/0/3	S5	no
	RHY414	Physics II: Electrisity and magnetism	B	6	1/1/1/3	no	PHY413
	PHY415	Physics III: Optics. Atomic physics					PHY414
	MAT103	Maths II	B	6	1/0/2/3	no	MAT101, MAT102
	MAT105	Ordinary differential equation. MATLAB	B	6	1/0/2/3	no	MAT101, MAT102
	Sub Total:			36	18		
3	5th semester (fall 2021)						
	GEN115	Dinamics	B	6	1/0/2/3	no	MAT105, PHY413, GEN153
	MCH445	Strengh of Materials	M	6	1/1/1/3		GEN171
	GEN168	Engineering Thermodynamics	B	6	1/0/2/3		
	GEN147	Intro to Electronic Measuring Systems	B	6	1/1/1/3	P1-3	GEN128
	GEN119	Fluid Mechanics	B	6	1/1/1/3		
	GEN167	Statistical Mechanics	B	6	1/1/1/3		MAT103
	GEN175	Computation Mechanics			1/1/1/3		GEN154
	Sub Total:			36	18		
4	7 trimester (fall 2022)						
	GEN174	Intro to Robots	M	6	1/1/1/3	no	
	ISO161	Design of Manufacture of Products	M	6	1/0/2/3	no	

Code	Name of disciplines	Cycle	The total volume of	classroom the volume of LK/lab/PR	Код Transfer	code prerequisite
2nd semester (spring 2020)						
LNG 1052	Elementary English (A1)	G	6	0/0/3/3	S4	LNG 1051
LNG 1053	General English 1 (A2)					LNG 1052
LNG 1054	General English 2 (A2)					LNG 1053
LNG 1055	Academic English (B1)					LNG 1054
LNG1056	Business English (B2)					LNG 1055
LNG 1057	Professional English (B2+)					LNG1056
Lng1012.1 test	Academic Kazakh (Russian) (B1)	G	4	0/0/2/4	S1	LNG1012
LNG1012. 2	Business Kazakh (Russian) (B2)					LNG1012.1
1101	ELECTIVES					LNG1012.2
MAT101 test	Maths I	B	6	1/0/2/3	no	MAT100
MAT102	Maths II					MAT101
PHY111	Physics I: Mechfnics. Molecular phisics and thermodynamics	B	6	1/1/1/3	no	PHY110
PHY112	Physics II: Electrisity and magnetism					PHY413
MAT124	Linear Algebra and Analytic Geometry	B	6	1/0/2/3	no	MAT100
CHE192	Chemstry	B	6	2/1/0/3	no	no
Sub Total:			34	17		
4th semester (spring 2021)						
LNG 1054	General English 2 (A2)	G	6	0/0/3/3	no	LNG 1053
LNG 1055	Academic English (B1)					LNG 1054
LNG1056	Business English (B2)					LNG 1055
LNG 1057	Professional English (B2+)					LNG1056
2102	Elective (B2+)					LNG1056
MAT106	Partial differential equations. MATLAB	B	6	1/0/2/3	no	MAT105, MAT102
GEN154	Numerical Methods and Programming	B	6	1/1/1/3		MAT103
HUM124	Philosophy	G	6	1/0/2/3	S6	no
PHY415	Physics III: Optics. Atomic physics	B	6	1/1/1/3		no
PHY421	Physics of materials			2/1/0/3		
GEN171	Statistic and Kinematics	B	6	2/1/0/3	S5	PHY111
Sub Total:			36	18		
6th semester (spring 2022)						
GEN170	Solid Mechanics	M	6	1/0/2/3		MCH445
GEN172	Engineering Materials	M	6	1/1/1/3	no	MCH445
GEN120	Theory and Design of Mechanism and Machines	M	6	1/1/1/3	no	GEN171
GEN173	Machine Element Design	M	6	1/1/1/3	no	GEN171
GEN206	Mechanical Systems Design	B	6	1/1/1/3		GEN119
GEN155	Numerical Methods for Solving Engineering Problems	B	6	1/1/1/3		GEN154
ROB127	Microcontroller control systems			2/1/0/3		no
HUM126	Social & Political Knowledge	O	8	4/0/0/4	S6	
Sub Total:			36	18		
8th trimester (spring 2023)						
GEN156	Dynamical System and Modeling	M	6	1/1/1/3		
ROB157	Automatics			2/1/1/3		

	GEN117	Heat Transfer	M	6	1/0/2/3				GEN169	Design of working systems	M	6	1/1/1/3	no	
	GEN160	Finite Elements in Engineering	M	6	1/1/1/3	no	MCH445		GEN159	Dynamics of Machines and Computer Analysis			2/1/1/3		
	GEN202	Vibration of Mechanical Systems			2/0/1/3		GEN115		GEN126	The Strength and reliability of Machines	M	6	1/0/2/3		MCH445
									PHY149	Quantum mechanics			2/0/1/3		PHY415
									GEN181	Laboratory: Hudromechanics	M	4	1/0/2/3		GEN119
									GEN180	Laboratory: Heat and Mass Transfer			2/0/1/3		GEN119
									ECA001	Preparation and writing of gradution project	FA	8			
									ECA002	Thesis defense	FA	6			
	Sub Total:			**24**	12				**Total:**			**36**	11		

Additional academic programmes (AAP)

Year of study	Code	Title	Credits	Semester
1	AAP106	Physical education I	2	1
1	AAP118	Physical education II	2	2
1	AAP015	Sport Club	0	2
1	AAP101	Training Practice	2	2
2	AAP109	Industrial internship I	2	4
3	AAP103	Industrial internship II	2	5
1		General Kazakh(latin alphabet)	2	2

Total number of credits

Cycles of subjects	Credits		
	prescribed	additional	total
Cycle of General subjects (G)	54	4	58
Cycle of Basic subjects (B)	132	0	132
Cycle of Majors (M)	48	28	76
Total of theoretical study	234	32	266
Extra educftion	0	12	12
Final attestation (FA)	14	0	14
Total:	248	44	292

5 Descriptors of the level and scope of knowledge, skills, and competencies

A-knowledge and understanding:

A1-forms and types of cultures, patterns of their functioning and development, history of culture of Kazakhstan;

A2-the main sources of the emergence and development of mass social movements, factors of social development;

A3-ethical legal norms regulating the relationship of a person to a person, society, and the environment;

A4-about modern achievements of natural Sciences, physical principles of operation of modern technical devices;

A5-about mathematics as a special way of knowing the world, the generality of its concepts and representations;

A6-about information, methods of its storage, development and transmission.

B-application of knowledge and understanding

B1-General principles and regularities of natural processes and phenomena from macro to nano scales; basic principles, methods of research and modeling of the surface, structure and properties of materials of various dimensions in modern production conditions;

B2-probe technologies; electro-physical, optical, quantum devices; spectroscopic, x-ray, analytical equipment, technical means of the space industry, computer technology and means of automated information processing; vacuum technology;

B3-issues of occupational health and safety, fundamentals of law and environmental legislation, fundamentals of patenting and scientific organization of work; independent development and promotion of various options for solving professional problems using theoretical and practical knowledge;

C -With the formation of judgments

C1 - in the methods of implementation of the main technical and technological processes of research, study, processing, modeling and formation of materials;

C2 – in experimental methods of studying materials, in analytical methods of information processing, in methods of calculating technical and technological parameters of production;

C3-in modern technologies for obtaining materials for solving priority production tasks.

D – personal abilities

D1-Have broad fundamental knowledge, be proactive, have the ability to adapt to the changing requirements of the labor market and technology, and be able to work in a team;

D2-Know the ethical and legal norms governing the relationship of a person to a person, society, and the environment, and be able to take them into account when developing environmental and social projects;

D3 –be Able to apply their knowledge and understanding in a way that is customary in the relevant professional field, and have competencies that manifest themselves in the ability to build arguments and make decisions in their field of knowledge;

D3 – Be ready to solve professional tasks in accordance with the training profile;

D4 – Be able to organize and manage research projects in modern conditions.

Competencies at the end of training

according to the program (Engineering mechanics):

- to own modern system of subject knowledge in the field of development projects perform specific professional tasks etc.;

Interdisciplinary:

- knowledge in development related Sciences and on modern needs of manufacturing industries materials and technologies; techniques and methods of mathematical processing of experimental and literature data on potential materials and alternative technologies; fundamental knowledge of physics, chemistry, biology.

B-Basic knowledge, skills and abilities

B1-work with electrophysical, optical, quantum devices, spectroscopic, x-ray, analytical and other equipment,

B2-perform qualified analytical processing of measurement data;

B3-own software products.

P-Professional competencies, including those required by industry professional standards (if any)

P1-a Wide range of theoretical and practical knowledge in the professional field, the implementation of production and technological types of professional activities;

P2-performing engineering tasks in the development of materials, devices, equipment, technologies by industry; conducting the necessary research and

measurements, using high-tech equipment; analyze and interpret the data obtained, draw conclusions;

P3-use the rules of safety and labor protection in the conditions of industrial activity.

O-Universal, social and ethical competencies:

O1-Ability to be guided by ethical and legal norms;

O2-Ability to work in an international context;

O3-readiness to realize the social significance of their future profession, self-development, professional development;

O4-the Ability to analyze socially significant processes and phenomena, to participate responsibly in social and political life.

C-Special and managerial competencies

C1-competence in production and management, design and engineering, organizational and technological, scientific and pedagogical areas based on modern training tools of information technologies and information resources.

C2-the ability to carry out professional functions in one or more activities based on the learning outcomes, taking into account the specifics of these activities, market requirements for organizational management, the professional competences.

Appendix to the diploma according to the ICES standard

Bachelor of engineering and technology, level 6 of the national qualifications framework.

Algebra and introduction to mathematical analysis
CODE-MAT100
CREDIT – 6 (1/0/2/3)
PREREQUISITE-diagnostic test

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the course is to introduce students to the basic ideas and concepts of algebra and mathematical analysis and to form the basic knowledge necessary for studying the course "Mathematics 1" .
The objectives of the course are the formation of skills for the study of athematical disciplines and the effective use of mathematical methods for solving research and practical problems in the professional field.

BRIEF DESCRIPTION OF THE COURSE

The course "Algebra and introduction to analysis" provides the basic concepts of algebra, mathematical analysis, differential and integral calculus.

KNOWLEDGE, SKILLS, SKILLS at the END of the COURSE

must know:
- basic concepts of algebra;
- basic concepts of mathematical analysis;
- basic elementary functions;

must be able to:
- find solutions to equations and inequalities, systems of equations and inequalities;
- convert algebraic and trigonometric expressions;
- to solve word problems;
- find the derivative of elementary functions;
- explore functions using the derivative;
- find the indefinite integral of elementary functions;
- find a definite integral;
- find the area of a curved trapezoid.

Mathematics I
CODE-MAT101
CREDIT – 6 (2/0/1/3)
PRECONDITION-diagnostic test/MAT100

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the course is to give the future specialist a certain amount of knowledge on the sections of the course "Mathematics -I", necessary for studying related engineering disciplines. Introduce students to the ideas and concepts of mathematical analysis. The main attention should be paid to the formation of basic knowledge and skills with a high degree of understanding of differential and integral calculus.

The objectives of the course are to acquire the knowledge necessary for the effective use of rapidly developing mathematical methods; to acquire the skill of constructing and researching mathematical models; to possess fundamental sections of mathematics necessary for solving research and practical problems in a professional field.

BRIEF DESCRIPTION OF THE COURSE

The course "Mathematics-I" provides an overview of the sections: introduction to analysis, differential and integral calculus

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

The study of this discipline will allow the student to apply the course "Mathematics-I" to solving simple practical problems, find tools sufficient for their research, and obtain numerical results in some standard situations.

Mathematics II
CODE-MAT102
CREDIT – 6 (1/0/3/3)
PRECONDITION-MAT100/MAT101

PURPOSE AND OBJECTIVES OF THE COURSE

Purpose of the course "Mathematics II" is the formation of bachelor's ideas about modern mathematics as a whole as a logically coherent system of theoretical knowledge.

The objectives of the course are to instill students with solid skills of solving mathematical problems with bringing the solution to a practically acceptable result. Develop primary skills of mathematical research of applied issues and the ability to independently understand the mathematical apparatus contained in the literature related to the student's specialty.

BRIEF DESCRIPTION OF THE COURSE

The course "MathematicsII" provides an accessible presentation of the following sections: elements of linear algebra and analytical geometry, differential calculus of functions of many variables, multiple integrals. "Mathematics II" is a logical continuation of the course "Mathematics I".

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

The study of this discipline will allow you to apply in practice the theoretical knowledge and skills obtained with a high degree of understanding in the course sections, use them at the appropriate level; translate into mathematical language the simplest problems posed in terms of other subject areas; acquire new mathematical knowledge using educational and information technologies; solve applied problems in the field of professional activity

Mathematics III
CODE-MAT103
CREDIT – 6 (1/0/3/3)
PRECONDITION-MAT101/MAT102

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the course "Mathematics-III" is to form basic knowledge and skills with a high degree of understanding in the sections of the course that help to analyze and solve theoretical and practical problems.

The objectives of the course are to instill students with the ability to independently study educational literature, conduct probability-theoretic and statistical analysis of applied problems; develop logical thinking and improve the overall level of mathematical culture.

BRIEF DESCRIPTION OF THE COURSE

The course "Mathematics-III" includes sections: series theory, elements of probability theory and mathematicaloй statistics and is a logical continuation of the discipline "Mathematics II".

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

Student
know:
- the theory of numerical series;
- theory of functional series;
- Fourier series;
-elements of probability theory and mathematical statistics;
be able to:
- to solve problems for all sections of the theory of series;
find the probability of events;
- find numerical characteristics of random variables;
- use statistical methods for processing experimental data;

Physics I: Mechanics. Molecular physics and thermodynamics,
Physics II: Electricity and magnetism, Physics III: Optics. Atomic physics.
CODE-PHYS413, PHYS414, PHYS415,
CREDIT-6 (1/1/1/3)
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE

The main purpose of teaching courses "Physics I: Mechanics. Molecular physics and thermodynamics., Physics II: Electricity and magnetism., Physics III: Optics. Atomic physics. " consists in the formation of ideas about the modern physical picture of the world and the scientific worldview.

BRIEF DESCRIPTION OF THE COURSE

Disciplines " Physics I: Mechanics. Molecular physics and thermodynamics., Physics II: Electricity and magnetism., Physics III: Optics. Atomic physics. " are the basis of theoretical training and engineering activities of graduates of the higher technical school and represent the core of physical knowledge necessary for an engineer operating in the world of physical laws. The Course "Physics I: Mechanics. Molecular physics and thermodynamics " includes sections: physical foundations of mechanics, structure of matter and thermodynamics. The discipline "Physics II: Electricity and magnetism" is a logical continuation of the study of the discipline " Physics I: Mechanics. Molecular physics and thermodynamics.", and forms a holistic view of the course of General physics as one of the basic components of the General theoretical training of bachelors of engineering and technical profile. Discipline of "Physics III: Optics. Atomic physics. " includes sections: optics, nanostructures, fundamentals of quantum physics, relativity theory, atomic physics.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

- the ability to use knowledge of fundamental laws, theories of classical and modern physics, as well as the use of physical research methods as the basis of the system of professional activity.

General chemistry
CODE-CHE192
CREDIT – 6 (2/1/0)
PREREQUISITE - diagnostic test

PURPOSE AND OBJECTIVES OF THE COURSE
The aim of the course is to Develop knowledge on fundamental issues of General chemistry and skills of their application in professional activities.
The goal of the course.:

- transfer the basic theoretical knowledge of the chemistry course;
- help students gain skills in performing laboratory work;
- teach you to solve typical problems and write reaction equations;

what contributes to the informal assimilation of theoretical material;
* develop students ' chemical thinking skills.

BRIEF DESCRIPTION OF THE COURSE

The course "General chemistry" examines the laws, theoretical provisions and onclusions that underlie all chemical disciplines, studies the properties and relationships of chemical elements based on the periodic law of D. I. Mendeleev and on modern ideas about the structure of matter, the basics of chemical thermodynamics and kinetics, processes in solutions, the structure of complex compounds.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of mastering the discipline, students should
1) know :

- basic chemical laws and concepts,
- various chemical systems,
- basic laws of chemical reactions,
- reactivity of substances based on knowledge of the structure of atoms, the periodic system of elements and chemical bonds.

2) be able to:

- solve problems using the acquired knowledge,
- to describe the reactions,
- perform calculations using basic chemical patterns.

3. master the skills:
- to be guided in the basic concepts of chemistry, properties of elements-nonmetals and metals of groups of the periodic system;

- acquire the skills of composing chemical equations, solving problems, explaining the properties of elements and their compounds based on the laws of chemistry, conduct chemical experiments and explain the phenomena that occur.

Modern history of Kazakhstan
CODE-HUM113
CREDIT – 6 (1/0/2/3)
PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course is to familiarize students of technical specialties with the main theoretical and practical achievements of domestic historical science on the problems of the history of modern Kazakhstan, a comprehensive and systematic study of the main stages of formation and development of Kazakh society.
Course objective:
- analyze the peculiarities and contradictions of the history of Kazakhstan in the Soviet period;
- to reveal the historical content of the foundations of regularities of political, socio-economic, cultural processes at the stages of the formation of an independent state;
- contribute to the formation of students civic position;
- to educate students in the spirit of patriotism and tolerance, belonging to their own people, fatherland;

BRIEF DESCRIPTION OF THE COURSE
The course Modern history of Kazakhstan is an independent discipline and covers the period from the beginning of the twentieth century to the present day. Modern history of Kazakhstan studies the national liberation movement of the Kazakh intelligentsia at the beginning of the XX century, the period of creation of the Kazakh ASSR, as well as the process of formation of a multinational society.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
- knowledge of events, facts and phenomena Of modern history of Kazakhstan;
- knowledge of the history of ethnic groups inhabiting Kazakhstan;
- knowledge of the main stages of formation of the Kazakh statehood;
- ability to analyze complex historical events and predict their further development;
- ability to work with all types of historical sources;
- ability to write essays and scientific articles on the history of the Fatherland;
- ability to operate with historical concepts;
- ability to lead a discussion;
- skills of independent analysis of historical facts, events and phenomena;
- public speech skills.

Kazakh/Russian language
CODE – ENG1012
CREDIT – 4 (0/0/2/2)
PRECONDITION-diagnostic test

PURPOSE AND OBJECTIVES OF THE COURSE
- teach students to listen to statements on well-known topics related to home, study, and leisure time;
- understand texts on personal and professional topics that contain the most common words and expressions;
- be able to conduct a conversation on everyday topics; describe their experiences; Express their opinions; retell and evaluate the content of a read book, seen a movie;
- be able to create simple texts on well-known topics, including those related to professional activities.

BRIEF DESCRIPTION OF THE COURSE
The language material of the course is selected in such a way that the student, assimilating the lexical and grammatical minimum, had the opportunity to get acquainted with typical communicative situations and himself in such situations, was able to correctly assess them and choose the appropriate model (strategy) of speech behavior.
The main emphasis of teaching is transferred from the process of knowledge transfer to learning how to use the language being studied in the course of performing various types of speech activities, such as reading (if you understand what is being read), listening (if you understand what is being read) and producing texts of a certain complexity with a certain degree of grammatical and lexical correctness.
The material for classes is chosen so that students, studying Kazakh/Russian, acquire reading, writing and understanding skills of sounding speech on the basis of simultaneous mastering of the basics of grammar (phonetics, morphology and syntax) and word usage in the course of constant repeated repetition with a gradual complication of tasks.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
By the end of the first semester, the student, subject to active organization of work in the classroom and conscientious completion of homework, acquires skills and abilities corresponding to the European level A2 (Threshold according to the ALTE classification), that is, is on the threshold of the level of independent language proficiency.

English
CODE-LNG1051-1057
CREDIT – 6 (0/0/3/3)
PRECONDITION-diagnostic test/LNG1051-1056

LNG1051
PURPOSE AND OBJECTIVES OF THE COURSE
The English language course "Beginner English" is designed primarily for learning from scratch. This course is also suitable for those who have only a General elementary knowledge of the language. After passing this level, the student will be able to confidently communicate on basic topics in English, learn the basics of grammar and lay a certain Foundation that will allow them to improve their skills at the next stage of studying English.
Post-requisites of the course: Elementary English.

LNG1052
PURPOSE AND OBJECTIVES OF THE COURSE
The discipline "Elementary English" is the Foundation of learning English, which is aimed at developing students ' receptive skills (reading and listening) and productive skills (writing and speech), analyzing basic knowledge, using and remembering the main grammatical rules and mastering the features of pronunciation and elementary vocabulary, as well as encouraging independent learning and critical thinking.
Pre-requisites for the course: Beginner.
Post-requisites for the course: General 1.

LNG1053
PURPOSE AND OBJECTIVES OF THE COURSE
The goalof the General English 1 course is to provide students with the opportunity to acquire sufficient knowledge to become more free in everyday social and academic settings. Students work on improving pronunciation, expanding vocabulary and grammar. At this level, the main task will be to consolidate the skills acquired earlier, learn how to compose and correctly apply complex syntactic constructions in English, as well as achieve a really good pronunciation.
Pre-requisites of the course: Elementary English.
Post-requisites for the course: General 2.

LNG1054
PURPOSE AND OBJECTIVES OF THE COURSE

The course "General English 2" is intended for students who continue to study “General English 1”. The course focuses on the ability to actively use in practice most aspects of the tenses of the English language, conditional sentences, phrases in the passive voice, etc. At this stage, the student will be able to hold a conversation with several interlocutors or Express their point of view. The student significantly expands their vocabulary, which will allow them to Express their thoughts freely in any environment. At the same time, the speech will be supplemented with various synonyms and antonyms of already familiar words, phrasal verbs and stable expressions.
Pre-requisites of the course: General 1.
Post-requisites of the course: Academic English.

LNG1055
PURPOSE AND OBJECTIVES OF THE COURSE
The main purpose of the English language course “Academic English” it is the development of academic language skills. This course is designed to help students become more successful and effective in their learning by developing critical thinking and independent learning skills.
Pre-requisites of the course: General 2.
Post-requisites of the course: Professional English.

LNG1056
PURPOSE AND OBJECTIVES OF THE COURSE
"Business English" is the English language for business communication, business and career. Knowledge of business English will be useful for conducting negotiations and business correspondence, preparing presentations and informal communication with business partners.
The special features of training are that it is necessary not only to master the vocabulary, but also to master new skills: presentation, communication, language, professional.
Pre-requisites of a course: IELTS score of 5.0 and/or Academic English
Post-requisites of the course: Professional English, IELTS score 5.5-6.0

LNG1057
PURPOSE AND OBJECTIVES OF THE COURSE
"Professional English" course is designed for B2+ level students, the purpose of which is to increase the language competence of students in the relevant professional areas. The main goal of the course is to teach students to work with texts, both audio and written, in their specialty. The curriculum is based on the necessary vocabulary (words and terms), often used in English for special purposes. Students will acquire professional English language skills through integrated content-and language-based learning, acquire vocabulary in order to read and understand original sources with a high degree of

independence, and practice various communication models and vocabulary in specific professional situations.
Pre-requisites of the course: Business English.
Post-requisites of the course: any elective course.

Informationand communication technologies (in English) yaz)
CODE-CSE174
CREDIT – 6 (2/1/0/3)
PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

Training in the use of modern information technologies in the field of professional activity. The course objectives include:
- To reveal the basic concepts of computer system architecture;
- To reveal the basic concepts of information and communication technologies and subject-specific terminology;
- Learn how to work with software interfaces of operating systems;
- Teach you how to work with data in different views, both tabular structured and unstructured;
- Teach you how to apply basic information security principles;
- Expand the concepts of data formats and multimedia content. Teach you how to work with standard multimedia data processing applications. Use modern approaches to the presentation of the material;
- Discover the concepts of modern social, cloud, and email platforms, and how to work with them;
- To teach to use methods of algorithmization and programming for solving problems of automation of business processes

BRIEF DESCRIPTION OF THE COURSE

The course contains a training program aimed at leveling the basic knowledge of students in the field of information and communication technologies. It contains a full range of topics, according to the standard curriculum of SSE, with the predominance of teaching practical skills in working with data, algorithmization and programming. The course is designed to teach students not only basic concepts of architecture and modern infrastructure of information and communication technologies, but also to teach them how to use these tools to solve problems of an applied nature. Teach you to optimize processes, apply adequate models and methods of solving practical problems using modern methods and tools of information technology, automate routine processes, be productive and efficient.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

Students will know:
Device to the computer;
- Architecture of computer systems;

- Information and communication technology infrastructure;
- Interfaces of modern operating systems;

Philosophy
CODE-HUM124
CREDIT – 6 (1/0/2/3)
PRECONDITION-no

PURPOSE AND OBJECTIVES OF THE COURSE

The goal of the course is to develop cognitive, operational, communicative, and self-educational competencies for problem solving:
- to promote the development of an adequate philosophical orientations in the contemporary world;
- to form creative and critical thinking among students;
- to distinguish the ratio of spiritual and material values, their role in the life of a person, society and civilization;
- contribute to defining your attitude to life and finding harmony with the world around you.

BRIEF DESCRIPTION OF THE COURSE

«Philosophy» is the formation of an integral worldview that has developed in the context of socio-historical and cultural development of mankind. Familiarization with the main paradigms of the methodology of teaching philosophy and education in the classical and post-classical traditions of philosophy. Philosophy is designed to develop stable life orientations, finding the meaning of one's existence as a special form of spiritual production. Promotes the formation of a moral image of a person with the ability of critical and creative thinking. The theoretical sources of this course are the concepts of Western, Russian, and Kazakh scientists on the history and theory of philosophy.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

- knowledge of the main terms, main concepts and problems of philosophy;
- knowledge of the main philosophical ways of solving worldview issues in the context of culture;
- ability to analyze the history of the development of philosophical thought;
- ability to identify alternative ways of raising and solving worldview issues in the history of human development;
- ability to identify the main theoretical approaches in the relationship of a person with society;
- ability to master the methodology of performing independent work;
- search and systematization skills;
- ability to debate freely and make rational decisions;
- skills of ethical principles in professional activities.

Ordinary differential equations. MATLAB
CODE-MAT105
CREDIT – 3 (1/1/1)
PREREQUISITE-Mathematics I-II

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of teaching the course " Ordinary differential equations. Matlab " is the formation of basic knowledge in the sections of the course that help to analyze, model and solve theoretical and practical problems using both analytical and numerical methods using Matlab; instilling students with the ability to independently study educational literature.
Tasks of the cadet to learn to recognize types and forms of integrable equations and systems, to integrate them and to apply differential equations for the mathematical solution of applied problems.

BRIEF DESCRIPTION OF THE COURSE

Ordinary differential equations of the 1st order.Higher-order ordinary differential equations. Systems of differential equations. Linear equations with variable coefficients. Numerical integration of differential equations and systems. Using Matlab to numerically solve differential equations.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

- master methods for solving ordinary differential equations;
- set mathematical problems;
- be able to build mathematical models;
- be able to solve problems modeled by differential equations using both analytical and numerical methods using Matlab

Partial differential equations MATLAB
КОД – MAT CODE127
CREDIT – 6 (1/0/2/3)
PRECONDITION-MAT126

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of teaching the course "Partial Differential Equations Matlab" is to form basic knowledge of the course sections, which help to analyze, model and solve theoretical and practical problems.
Course objectives: apply the theory of partial differential equations to solve and research applied problems from various fields of natural science, Economics, medicine, biology and ecology; form ideas about the implementation of numerical methods for solving boundary value problems using Matlab.

BRIEF DESCRIPTION OF THE COURSE

Basic equations of mathematical physics. Classical boundary value problems for partial differential equations. Analytical and numerical methods for solving classical boundary value problems. Using Matlab for numerical solution of boundary value problems.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

- master the given mathematical apparatus that allows you to analyze, model and solve classical boundary value problems;
- master the methods of solving classical boundary value problems;
- be able to pose a problem, choose methods of solution, both in analytical form and using computer technologies;
- use modern software-Matlab package;
- master the methodology and skills of numerical implementation of a mathematical model, analysis of the results obtained, interpretation of them to Refine the model;
- independently expand your mathematical knowledge.

Engineering graphics
CODE - GEN111
CREDIT – 6 (1/1/1/3)
PRECONDITION - no

COURSE GOALS AND OBJECTIVES

- study of the theoretical foundations of performing and reading design documents, methods for constructing spatial forms on a plane, methods for solving engineering and technical problems in a drawing, developing students ' spatial thinking and instilling independent work skills;
- teaching students to work with various по types и of graphic information, the basics of graphical representation of information, methods of graphical modeling of geometric objects, rules for the development and design of design documentation, graphic models of phenomena and processes;
- students will master the methods and tools of machine graphics, acquire knowledge and skills in working with the computer-aided design system AutoCAD.

BRIEF DESCRIPTION OF THE COURSE

The study of ways to obtain certain graphical models of space based on orthogonal projection and the ability to solve моделях problems related to spatial forms and relations on these models . Mastering the basic principles and methods of geometric modeling and the methodology for developing graphical applications.

Mastering the knowledge of drawing construction, the ability to read and compose graphic and textual design documentation in accordance with the requirements of regulatory documents and state standards. Introduction of students to the concept of computer graphics, geometric modeling, graphic objects, modern interactive graphic systems for solving problems of automation of drawing and graphic works on the example of AutoCAD.

Formation of skills in using universal graphic systems for developing and editing drawings с using three-dimensional computer modeling, автоматизации design automation in relation to the development and execution of design documentation.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of studying the discipline, the student must:

know:

- theoretical basis for obtaining complex and axonometric drawings;

- methods for constructing images – views, sections, and cross-sections- of both existing and newly created products;
- rules for executing and executing drawings, drawing up design and text documents established by the legislation of the Russian Federation. GOST standards;
- the types of connections of the component parts of products, their images and symbols;
- methods for constructing surface scans.

be able to:

- build complex and axonometric drawings of geometric images;
- perform text and graphic design documentation;
- read the Assembly drawing and execute working drawings and sketches in accordance with GOST;
- navigate freely in projections with numerical marks;
- work in the universal autocad environment with both 2M views and 3M objects.

have the following skills:

- executing and reading an Assembly drawing;
- constructing flat projection models of three-dimensional space;
- solutions to positional and metric problems;
- proficiency in modern computer -aided design tools.

possess the following competencies:

- ability to apply methods of graphical representation of objects of professional activity, for example, objects of mechanical engineering, diagrams and systems;
- willingness to use information technologies, including modern средства computer graphics tools, in their subject area;

- willingness to participate in the development of design and operational design documentation in accordance with standards, specifications, and other regulatory documents.
- of threats to information security, principles, tools and methods of data protection;
- python programming language.

Students will be able to:

- Work with the interfaces of modern operating systems;
- Work with modern application software for working with data of various types and purposes;
- Use modern social, cloud, and email platforms to organize business processes;
- Programming in an algorithmic programming language;
- Analyze, model, design, implement, test and evaluate information and communication technology systems.

Statics and Kinematics
CODE – GEN1713
CREDIT - 6 (1/0/2/3)
PREREQUISIT - Mathematics I, II. Physics I: Mechanics. Molecular Physics and Thermodynamics

PURPOSE AND OBJECTIVES OF THE COURSE
Formation of students' scientific foundations of knowledge of the laws of nature associated with the conditions of equilibrium and the movement of material bodies. Preparation of a scientific and theoretical basis for the development of special disciplines and the foundations of modern technology. To acquaint students with the various properties of forces and conditions of balance, the study of the main types of motion of a point and a body from a purely geometric point of view. Involving students in the development and solution of problems that contribute to bridging the gap between scientific theory and engineering practice

SHORT DESCRIPTION OF THE COURSE

Statics. System of converging forces. The theory of moments. The main theorem of statics. Arbitrary flat system of forces. Friction. Arbitrary spatial system of forces. Center of gravity of the body. Kinematics of point. The simplest movements of a rigid body. Plane-parallel motion of a rigid body. Complex point movement. Complex motion of a rigid body.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

As a result of studying the discipline, the student must

know:

- the basic laws of equilibrium and interaction of material bodies;
- methods of constructing mathematical models of the physical processes under consideration;
- mathematical methods for solving problems.

be able to:

- choose adequate mathematical models;
- analyze the decisions received and draw conclusions or develop appropriate recommendations;

- formulate your own conclusions and justify them;
- work with open resources.

have the skills:

- construction of mathematical models of the processes under consideration in the form of differential equations;
- solutions of the corresponding differential equations;
- analysis of the received decisions and their independent interpretation;
- develop and deepen your own knowledge.

have the following competencies:

- willingness to apply fundamental laws of nature and basic physical laws in the field of mechanics
- ability and willingness to use the studied material in their subject area;
- willingness to use information technology to solve dynamic problems;
- willingness to analyze the results and summarize them;
- willingness to work not only independently, but also in a team.

Dinamics
КОД – GEN1153
CREDIT - 6 (1/0/2/3)
PREREQUISIT - Mathematics I, II. Physics I: Mechanics. Molecular Physics and Thermodynamics, Ordinary Differential Equation. Matlab

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ЦЕЛЬ И ЗАДАЧИ КУРСА
Formation of students' scientific foundations of knowledge of the laws of nature associated with the conditions of equilibrium and the movement of material bodies. Preparation of a scientific and theoretical basis for the development of special disciplines and the foundations of modern technology. Introduce students to the main types of motion of mechanical systems, principles and calculations for the stability of equilibrium and motion of mechanical systems. Involving students in the development and solution of problems that help bridge the gap between scientific theory and engineering practice

SHORT DESCRIPTION OF THE COURSE
The course includes the necessary data on the dynamics of a material point and a solid body, the concepts of oscillatory motion of various mechanical systems, the analysis of the conditions of stability of equilibrium and motion of material objects, the solution of the corresponding equations. Getting skills in building mathematical models of material objects, engineering processes and their analysis based on the solutions found.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE
As a result of studying the discipline, the student must
know:

- the basic laws of motion and interaction of material bodies;
- methods of constructing mathematical models of the physical processes under consideration;
- mathematical methods for solving problems.

be able to:

- choose adequate mathematical models;
- analyze the decisions received and draw conclusions or develop appropriate recommendations;
- formulate your own conclusions and justify them;

- work with open resources.

  have the skills:

  - construction of mathematical models of the considered processes in the form of differential equations;
  - solving the corresponding differential equations;
  - analysis of the obtained solutions and their independent interpretation;
  - development and deepening of their own knowledge.

  have the following competencies:

- readiness to apply fundamental laws of nature and basic physical laws in the field of mechanics
- ability and willingness to use the studied material in their subject area;
- willingness to use information technology to solve problems of dynamics;
- willingness to analyze the results obtained and generalize them;
- willingness to work not only independently, but also in a team.

Strength of materials
CODE-MCH445
CREDIT – 6(1/1/1/3)
PREREQUISITE-Mathematics I, II. Physics I: Mechanics. Molecular physics and thermodynamics. Statics and kinematics

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PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the course: to teach the future engineer the basics of the science of strength, rigidity and stability of materials and structures, to prepare him for the correct choice of calculation and design methods, to familiarize him with the latest achievements of science and technology in the field of mechanics of a continuous deformable body, to develop students ' logical thinking, self-thinking skills necessary in further work when solving various problems of natural science and technology.
Course objectives:

- study of the fundamentals of the strength of materials (definitions, theorems, laws), practical methods of their application;
- in preparation for the study of other General engineering and special disciplines;
- in the light of General communication and motives of separate concepts, to replace private study a more General systematic methods;
- in the development of students ' logical thinking, skills of independent thinking and decision-making, which are necessary in further work when solving certain problems of natural science and technology.

BRIEF DESCRIPTION OF THE COURSE

The course "Strength of materials" examines the laws, theoretical provisions that underlie the mechanics of a deformable solid. Methods of calculation of structural elements for strength, stiffness and stability, methods of calculation and design in the General case of the action of forces, dynamic action of forces, calculation of structural elements beyond elasticity.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

In accordance with the objectives of teaching the strength of materials, students should:
<u>have an idea:</u>

- about the elements of machine-building structures, about modern methods of calculating these elements for strength, rigidity and stability;
- on ways to improve the efficiency, reliability and cost-effectiveness of machine and instrument designs;

<u>know:</u>

- basic concepts and topics included in this program;
- interrelation, interdependence and mutual influence of these concepts not only among themselves, but also with other disciplines;
- sections of the course devoted to the main types of deformation (tension, compression, torsion, bending), mechanical properties of the most important structural materials, stress state theory, strength hypotheses, General case of forces, calculation of statically indeterminate systems, calculation of stability, dynamic action of forces, calculation of structural elements beyond elasticity;

be able to:

- accurately and thoroughly argue the course of reasoning, without cluttering it with unnecessary details;
- apply the studied material in diverse areas;
- possess skills:
- be guided in the basic concepts of deformable solid mechanics;
- acquire skills in solving problems related to various types of deformations of mechanical systems;
- acquire skills in the experimental study of the mechanical properties of materials, the stress-strain state of the simplest structural elements, the handling of modern testing machines and measuring equipment;

Engineering Thermodynamics
CODE – GEN168
CREDITS – 6 (1/0/2/3)
PREREQUISITE – Mathematics I, II. Physics I. Numerical Methods & Programming

COURSE GOALS AND OBJECTIVES

Study of the main methods for determining the energy efficiency and thermal performance of heating engineering devices, modern technologies in the field of heat engineering, based on renewable energy sources. To acquaint students with experimental measurements and calculations of the efficiency of solar thermal collectors and heat pumps. Obtaining knowledge on mathematical modeling of heat and mass transfer processes in complex heat engineering devices. The main objective of the course is the formation of knowledge on the basics of thermodynamics and heat transfer in various fields of engineering, in particular, in energy.

COURSE BRIEF DESCRIPTION

The first and second law thermodynamic analysis. Energy and exergy analysis. Basic heat engineering diagrams. TRNSYS 18.0 modeling. EES (Engineering Equation Solver) modeling. Mathematical modeling of heat exchange processes in complex heat engineering devices based on heat balance. Hydraulic calculations. Selection of completing equipment for heating engineering. Fundamentals of refrigeration and heat pumps. Experimental calculation methods in heat engineering. Big data programming and analysis.

KNOWLEDGE & SKILLS AFTER THE COURSE COMPLITION
Student
should know:

- fundamentals of thermodynamics and heat transfer in various fields of engineering;
- modern technologies in the field of heat engineering;
- basic heat engineering diagrams;
- system modeling;
- experimental methods of calculation in heat engineering.

should be able to:

- use licensed software - TRNSYS 18 and EES;
- to carry out the first and second law thermodynamic analysis to determine

useful heat and heat losses at the nodes of the thermal system;
- experimentally measure and calculate the efficiency of solar thermal collectors and heat pumps;

should have skills:

- design and selection of heat supply systems for buildings;
- mathematical modeling of heat and mass transfer processes in complex heat engineering devices;
- build mathematical models based on heat balance;
- carry out own computer programming for heat balance numerical calculations;

should have competencies:

- ability to carry out analytical calculations, thermal cycles/circuits;
- readiness to carry out mathematical calculations on licensed software;
- ability to solve issues of combining renewable energy;
- willingness to work in a team.

Fluid Mechanics
CODE - GEN119
CREDIT - 6 (1/1/1/3)
PREREQUISIT - Mathematics I, II, III. Physics I: Mechanics. Molecular Physics and Thermodynamics. Ordinary differential equations. Partial differential equations.

PURPOSE AND OBJECTIVES OF THE COURSE

Purpose of the course: Formation of students' knowledge of fundamental issues of fluid mechanics and the acquisition of skills in applying the knowledge and methods gained to solving practical problems.
Objectives of the course:

- transfer theoretical foundations in the fluid mechanics discipline;
- use the fundamentals of fluid mechanics to solve technical problems in professional activities, apply methods of mathematical analysis and modeling in theoretical and experimental studies of fluid flow in systems of buildings and structures;
- to form students' skills in solving applied problems of fluid mechanics.

SHORT DESCRIPTION OF THE COURSE

The discipline "Fluid Mechanics" examines the models and physical properties of liquids and gases; forces acting in a fluid, hydrostatic pressure and its properties; basic equations and laws of equilibrium and motion of liquids and gases; flow regimes and solving methods of applied problems.

KNOWLEDGE, ABILITY, SKILLS AFTER COMPLETION OF THE COURSE

As a result of mastering the discipline, students should
know:

- physical properties of fluids;
- basic hydraulic quantities and their dimensions;
- basic concepts, relationships and laws of fluids statics, kinematics and dynamics;
- hydraulic laws of pressure driven fluid flows in and channels and the principles of their hydraulic calculation;
- methods for calculating flows of liquids and gases;

- basic calculation formulas and methods of their application to solving problems of engineering practice.

be able:

- apply the basic laws of statics, kinematics and dynamics of fluids;
- distinguish between fluid flow regimes and apply corresponding methods for solving problems;
- independently build a design scheme and find the right solution to the problem

be skilled:

- • independent work with educational and scientific literature;
- predicting the behavior of the main hydraulic parameters and flow characteristics in engineering systems and devices of buildings and structures;
- • application of theory to solving specific problems.

Solid state mechanics
CODE-GEN205
CREDIT – 6 (1/0/2/3)
PREREQUISITE-Mathematics I, II. Physics I. The strength of the materials.

PURPOSE AND OBJECTIVES OF THE COURSE

Deformable solid mechanics studies the laws of deformation of real solids under the action of external forces applied to them, temperature, magnetic fields and other external influences. For engineers, it is of paramount importance from the point of view of its application to the determination of the stress-strain state (to resolve issues of strength, stiffness, vibrations, etc.) of real structures. In this regard, knowledge of the basics of deformable solid mechanics is extremely important in the training of highly qualified engineering personnel, including in the field of mechanical engineering.

The main task of deformable solid mechanics is to describe the deformation processes taking into account experimental data that determine the relations that could be used in solving specific technical problems. Therefore, the development of the theory of mechanics of a deformable solid follows the path of gradual complication and refinement of the determining relations with the accumulation of experimental data. Deformation is usually taken as the main initial characteristic.

The purpose of the discipline: to give students the theoretical foundations and practical skills of solving engineering problems using the basic equations and methods of mechanics of a deformable solid, to develop students ' logical thinking, self-thinking skills necessary in further work when solving certain problems of natural science and technology. The study and development of the discipline is based on the application of the basic provisions and methods of vector and matrix algebra, differential calculus, theoretical mechanics and the resistance of materials

BRIEF DESCRIPTION OF THE COURSE

The theory of stresses. Theory of deformations. Physical equations. Complete system of equations of elasticity theory. Methods for solving problems in the theory of elasticity. The exact solution. The simplest inversely symmetric problems of elasticity theory (torsion of rods). Approximate methods for solving problems in the theory of elasticity. Plane problem of elasticity theory. Elementary solutions using the stress function. Applying the equations of a plane problem to concrete examples. Plane problem of

elasticity theory in polar coordinates. Axisymmetric problems. Non-axisymmetric problems. Theory of bending of thin plates.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

In accordance with the objectives of teaching elasticity theory, students should:

have an idea of:

- the current state of the problem and methods of studying the stress-strain state of solid elastic bodies;
  know the sections of the course devoted to:
- studying the stressed and deformed state of a solid elastic body;
- basic equations and methods for solving problems of elasticity theory;
- solving specific problems of applied importance in mechanical engineering (calculation of a thick-walled cylinder, torsion of non-circular beams, contact problems, thermoelasticity problems, etc.);
  be able to:
- make calculation schemes;
- to make the basic equations and applied methods theory of elasticity for the solution of applied problems;
- analyze the stress state at dangerous points and correctly apply the basic hypotheses of the classical theory of elasticity;
  acquire practical skills:
- determination of stresses, deformations and displacements in a rigid elastic body;
- in reading the literature on some questions of the theory of elasticity

Theory and design of mechanisms and machines
CODE-GEN120
CREDIT – 6 (1/1/1/3)
PREREQUISITE-Mathematics I, II. Physics I. Statics and kinematics.

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of studying the disciplines is to form the necessary initial knowledge base on General methods of analysis and synthesis of mechanical systems, which are the basis of technological equipment used in the field of future professional activity of the graduate. Mastering General methods of studying the structure, geometry, kinematics and dynamics of typical mechanisms and machines. Development of knowledge, skills and abilities for analyzing the structure and performing geometric, kinematic and dynamic calculations of mechanisms and machines. The development of modern methods of designing and modernization of mechanisms and machines, including computer technology

BRIEF DESCRIPTION OF THE COURSE

The course includes basic concepts of machine elements and basic types of mechanisms. Structural analysis and synthesis of mechanisms. Kinematic analysis of mechanisms with lower pairs. Dynamics of machines and mechanisms. Synthesis of mechanisms. Design of mechanisms with the required properties.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of studying the discipline, the student should

know:

- the principles of operation of individual mechanisms and their interaction in the machine;
- basic methods for evaluating the structure, kinematic and dynamic characteristics and functional capabilities of typical mechanisms and machines;
- General theoretical foundations of analysis and synthesis of mechanisms and machines and methods
- optimization in the design and modernization of mechanisms and machines using computer technology to be

be able to:

- independently determine the kinematic characteristics of mechanisms and machines;

- perform dynamic calculations of machines;
- calculate the energy balance of mechanisms and machines;
- carry out design work on the creation and modernization of machinery and equipment.

have the skills:

- independent analysis of the structure and determination of the main parameters of mechanisms and machines during design work;
- decision-making in relation to the analysis and synthesis of mechanisms and systems, based on the specified conditions;
- studies of the kinematic and dynamic properties of the mechanism according to a given scheme of the mechanism and given dimensions.

have the following competencies:

- ability to draw up structural and kinematic schemes of mechanisms;
- possess General (typical) methods and algorithms for analysis and synthesis of mechanisms and systems formed on their basis;

willingness to participate in the collection and analysis o

Design of machine elements
CODE-GEN173
CREDIT – 6 (1/1/1/3)
PREREQUISITE-Static and kinematics. The strength of the materials.

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of studying the disciplines is to form the necessary initial knowledge base of students on the basics of theory, design calculation, design of parts and elements of machines, development and design of design documentation used in the field of future professional activity of the graduate. Development of knowledge, skills and abilities of selection, analysis of joints, bearings, shafts, gears and other machine elements, as well as their design using computer technologies.

BRIEF DESCRIPTION OF THE COURSE

The course includes the concepts of parts and elements of machines, considers the main issues of ensuring their performance. The main objectives of the discipline are: the study of General principles of design and construction, the construction of models and algorithms for calculating typical parts and elements of machines, taking into account the main performance criteria, the development of design skills.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of studying the discipline, the student should
know:

- the main criteria for the performance of machine elements and the types of their failures;
- typical designs of machine parts and components, their properties and applications;
- fundamentals of the theory and methodology for calculating typical machine parts and components;
- basic design of machine parts and components;
- computer software modules for automating calculations in the design of machine elements.

be able to:

- choose a calculation model and perform energy-kinematic calculation;
- select an electric motor;
- perform calculations of machine elements in the design process;
- carry out verification calculations of machine elements according to permissible stresses;

- use modern computer technologies in the calculation and design of machine elements;

have the skills:

- kinematic calculation of the mechanical drive of machines;
- calculation and design of standard parts and elements of various transmission mechanisms;
- calculation and design of detachable and non-detachable connections;
- computer-aided design and development of working drawings of typical parts, components and assemblies of machines.

have the following competencies:

- ability to design elements of machines of the required purpose according to the specified output data;
- choose the most suitable materials for machine elements and use them efficiently;
- perform calculations of machine parts and components using reference literature and GOST Standards.
- ability to collect and analyze raw data for the design of machine elements using regulatory documentation and information retrieval and processing methods.

Basics of heat transfer

CODE – GEN117

CREDIT – 6 (1/0/2/3)

PREREQUISITES– Mathematics I, II. Ordinary differential equations. Fluid and gas mechanics.

PURPOSE AND OBJECTIVES OF THE COURSE

Purpose of the course: Formation of students understanding of the physical nature of heat transfer processes, theoretical, experimental and computational methods used in the study of these processes, methods of generalization of the results obtained, as well as skills for solving applied problems.

Objective of the course:

- introduce students to the fundamental principles and laws of heat transfer and teach them how to apply these principles to the study of system behavior;
- formulate the models necessary for the study, analysis and design of heat transfer systems through the application of these principles;
- develop the problem-solving skills needed for good heat transfer engineering practice in real-world applications.

BRIEF DESCRIPTION OF THE COURSE

As part of the course «Basics of heat transfer», students will get acquainted with the main types of heat transfer, as well as models describing the process of heat transfer and methods for calculating applied heat transfer problems.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of mastering the discipline, students should

know:

- basic concepts of heat transfer mechanisms, regularities and calculated heat transfer ratios;
- main regularities of heat transfer processes in modern technical devices;
- the main methods and methods of their application to solving problems of engineering practice.

be able to:

- perform calculations of the thermal state of structural elements of thermal power devices;

- identify, formulate and solve problems related to heat transfer;
- perform calculations of heat transfer in energy systems;
- independently build a calculation scheme and find the correct solution to the problem;

possess skills:

- independent work with educational and scientific literature;
- applications of heat transfer knowledge to solve heat transfer problems;
- design, analyze and interpret data related to heat transfer .

Introduction to robotics
CODE - GEN174
CREDIT – 6 (1/1/1/3)
PREREQUISITE-Mathematics I, II. Statics and kinematics. The strength of the materials. Dynamics

PURPOSE AND OBJECTIVES OF THE COURSE

- teaching students basic methods of robotics and automation
- acquisition of skills in writing equations and programming in the Matlab system of kinematics, dynamics and sensing of robots
- simulation, real-time control of real robotic systems and manipulators (in the Matlab system).

BRIEF DESCRIPTION OF THE COURSE

Study different types of robots. Methods determination of the position and speed of robot links. Coordinate systems of the robot, recording equations of direct and inverse kinematics of the robot, solution in the Matlab system. Recording of differential equations of robot motion, solution in the Matlab system. Control when the robot moves along the trajectory. Power management. The use of different sensors in the robots. Simulation of manipulators and robots.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE
As a result of studying the discipline, the student
should know:

- classification and analysis of robot types
- theoretical foundations of methods for determining the position and velocities of robot links;
- recording of equations of direct and inverse kinematics of the robot and their programming in the Matlab system;
- recording of differential equations of robot motion and their solution in the Matlab system;
- creating controls when the robot moves along the trajectory;
- creating a power management;
- use of various sensors in robots;
- methods for modeling manipulators and robots in computer systems.

be able to:

- classify and analyze different types of robots;

- enter coordinate systems and determine the positions and speeds of the robot links;
- write and solve equations of direct and inverse kinematics, robot dynamics in the Matlab system;
- introduce sensors into robots and simulate manipulators and robots in computer systems.

have the skills:

- entering the coordinate system and determining the position and speed of the robot links;
- records and solutions in the Matlab system of equations of direct and inverse kinematics, robot dynamics;
- input of sensors into robots and simulation of manipulators and robots in computer systems.

have the following competencies:

- ability to apply methods for determining the position and speed of robot links in the Matlab environment, for calculating and designing robots;
- readiness to use information technologies, including modern computer tools, in robotics;
- willingness to participate in the design of new robots in mechanical engineering.

Design of mechanical systems
CODE - GEN206
CREDIT – 6(1/1/0/3)
PREREQUISITE-Mathematics I, II. Physics I. Numerical methods and programming. Design of machine elements

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PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the discipline is to provide students with knowledge in the field of engineering design of various types of mechanical systems using modern computer programs.

Tasks of the discipline:

- master the methods of making models for machine components;
- master methods for determining stresses in machine nodes both by analytical methods and with the help of computer programs for finite element analysis;
- study the methodological basis of design;
- master a range of the latest computer-aided design tools;
- to form an idea of modern graphic packages intended for design work;
- master the system of theoretical and practical knowledge about modern methods of calculating various mechanical systems;
- master the skills of design and strength calculations of parts of various degrees of complexity

BRIEF DESCRIPTION OF THE COURSE

The course combines theory and practice, as well as a wide range of design tools required for a mechanical engineer. Classical engineering disciplines are combined with courses on the latest computer modeling tools, such as finite element methods, optimization methods, and methods for analyzing many-body systems. The article deals with the use of various types of computer programs in engineering design. The calculation of stresses, assessment of deflections, static failures, loss of stability of structural elements under combined loads is carried out. In laboratory classes, modeling and construction of mechanical systems related to real-world applications are carried out

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of studying the discipline, the student should
know:

- design stages, their sequence and content;
- basic terminology in the field of computer-aided design;
- the overall structure design;
- content and formulation of the main classes of problems solved in CAD conditions;
- basic methods of geometric modeling.
- transition from the design scheme to the actual design and Vice versa;
- specifics of design work in CAD;

be able to:

- work with the necessary software;
- solve specific technological problems on CAD hardware;
- independently define design goals and set tasks;
- apply methods for solving problems of the design of mechanical systems;
- perform basic calculations and prepare the necessary technical documentation automatically.

have the skills:

- use of information and communication technologies;
- work in computer networks and the Internet;
- work with patent information taking into account the requirements of information security.

have the following competencies:

- ability to solve standard tasks of professional activity
- ability to model technical objects and technological processes
- knowledge of the methodology for designing mechanical systems using standard packages and computer-aided design tools;
- the ability to use new knowledge and skills in practical activities;
- willingness to work in a team, communicate effectively with colleagues, management, and consumers;
- willingness to take responsibility for the work of team members (subordinates).

Product design and production
CODE-ISO161
CREDIT – 6 (1/0/2/3)
PREREQUISITE - Mathematics I, II. Physics I. II.

PURPOSE AND OBJECTIVES OF THE COURSE

The subject of the course "Design and production of products" is modern rational and widespread in the industry progressive technological methods of forming blanks and machine parts by casting, pressure treatment, welding, mechanical processing by cutting and other methods.

The purpose of the course is to give students knowledge about the main technological methods of forming parts, to acquaint them with the possibilities of modern mechanical engineering, as well as with the prospects for the development and improvement of various technological methods of processing.

The objectives of the course include:

a) the study of the physical nature of the main technological methods for obtaining blanks and machine parts by casting, pressure treatment, welding, as well as mechanical processing by cutting and other methods ;

b) study of the mechanical foundations of technological methods of forming blanks and parts;

c) study of technological capabilities and methods, their purpose, advantages and disadvantages, and areas of application;

d) study of the basic schemes of operation of technological equipment, tools, devices, their purpose and application;

e) familiarizing students with the basic concepts and information about the manufacturability of the structures of blanks and machine parts, taking into account the methods of their production and processing.

Mastering this course is based on the knowledge received by students at studying the following sections of passed disciplines: from chemistry processes for the production of metals from raw materials, their chemical properties, structure and state diagrams; of course in physics - physical properties of solid, liquid and gaseous bodies, the atomic-molecular structure of materials; of course drawing

- ability to read and execute sketches, diagrams, drawings.

Quantum Mechanics
CODE-PHY149
CREDIT – 6 (2/0/1/3)
PREREQUISITE-PHY414

PURPOSE AND OBJECTIVES OF THE COURSE

Assistance to students in achieving their expected learning outcomes in the discipline, which correspond to the planned learning outcomes in the specialty.

BRIEF DESCRIPTION OF THE COURSE

Principles of quantum mechanics. Application of the stationary Schrodinger equation for solving some problems. Motion of microparticles in the field of central forces. A hydrogen atom. Quantum statistics. Optical quantum generators. Magnetic characteristics. Elementary particles.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

Demonstrate the ability to put into practice knowledge and understanding of the basic concepts, principles, theories and facts related to quantum physics, in particular quantum mechanics. Demonstrate the ability to apply the acquired knowledge of quantum mechanics to the formulation, formulation and solution of applied scientific problems in technical physics, using recognized quantum mechanical methods. Demonstrate the ability to conduct a literary review of unsolved problems, independently formulate a scientific problem of a fundamental or applied nature, find methods for solving problems, analyze and present the results obtained in the necessary form and draw conclusions.

Machine dynamics and its computer analysis
CODE-GEN159
CREDIT – 6 (2/1/0/3)
PREREQUISITE – Dynamics. Theory and design of mechanisms and machines.

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of studying the discipline "Machine dynamics and its computer analysis" is to form ideas about the dynamic processes that take place during the operation of machines and mechanisms and take them into account in the design.

Tasks of the discipline:

- introduce special knowledge on determining the kinematic and dynamic characteristics of machines and mechanisms;
- teach the transition from a real machine to an abstract equivalent circuit, taking into account its structural and elastic properties;
- introduce the analytical methods of studying the operating modes of the machine;
- teach you to determine the initial data for subsequent calculations of drive power, performance, machine strength, durability;
- teach the use of standard computer programs for modeling computational schemes.

BRIEF DESCRIPTION OF THE COURSE

Equivalent circuits and mechanical characteristics of machines and their drives are considered. The laws of motion of machines with different mechanical characteristics are studied. The problems of the theory of dynamics of machines with concentrated and distributed parameters are presented. Methods of reducing dynamic loads are proposed and investigated. Computer analysis and synthesis of dynamic systems is given using the mathematical package MATHLAB.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of studying the discipline, the student should
know:

- methods for determining reactions in the connections of the links of the mechanism;
- methods for determining the inertia forces of a solid body in various cases of its motion;
- principles of static and dynamic balance of mechanisms;
- theoretical foundations and methodological basis of analytical dynamics, its current problems and terminology;
- Lagrange equations, their derivation, structure and meaning of each term;
- Lagrange equation for potential forces;

- equations of forced oscillations of the system taking into account the resistance forces and without taking them into account.

be able to:

- develop kinematic schemes of mechanisms;
- determine the loads in the links of kinematic circuits;
- determine deformations of structural elements;
- create an equation of motion for a system of solids;
- solve systems of differential and algebraic equations.

have the skills:

- drawing up differential equations of motion;
- calculation of deformations of structural elements under various types of loading.
- numerical study of the obtained analytical results;
- performing verification of the obtained results for compliance with the general laws and theorems of analytical dynamics;
- applications of computer-aided design and computer-aided analysis software systems.

have the following competencies:

readiness to apply the physical and mathematical apparatus, theoretical, computational and experimental research methods, methods of mathematical and computer modeling in the process of professional activity;

readiness to master new modern methods and means of conducting experimental research on the dynamics and strength, stability, reliability, friction and wear of machines and devices;

independently master and apply new systems of computer mathematics and systems of computer design and computer engineering to effectively solve professional problems.

Dynamic systems and their modeling
CODE - GEN157
CREDIT – 6 (2/1/0/3)
PREREQUISITE-Mathematics I, II. Statics and strength of materials.

PURPOSE AND OBJECTIVES OF THE COURSE

- Objectives of the course «Dynamic systems and their modeling»:
- teach students the ability to create models with components from various fields of technology;
- to introduce in the model the components of accumulation and dissipation of energies from different areas;
- get equations of the state space of the course Problem:
- learn how to use the MATLAB and Simulink computer system to solve, analyze and visualize results;
- be able to interpret the results obtained when designing such systems.

BRIEF DESCRIPTION OF THE COURSE

Description of the discipline. This course is devoted to modeling engineering systems containing components from various fields of technology, to create a system for designing and managing such systems. The course also describes methods for creating models, obtaining equations of the state space, introduction to the model of energy accumulation and dissipation from various fields, nonlinear mechanics, transformation theory.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of studying the discipline, the student
should know:

- the theoretical basis for creating various dynamic models from various fields of technology;
- MATLAB and Simulink computer systems;
- types of calculations performed and ways to configure them;
- methods of modeling and analysis of systems;
- principles of building models

be able to:

- perform analysis of the system or process under study;
- choose the modeling method reasonably;
- build an adequate model of the system or process using modern computer tools;

- interpret and analyze simulation results.

have the skills:

- methods and techniques of working in MATLAB and Simulink based on the experience gained during laboratory work;
- work and use in the course of modeling scientific and technical information, Internet resources, databases and catalogs, electronic journals and patents, search resources, etc. in the simulated area, including in a foreign language.

have the following competencies:

- the ability to independently learn new research methods, to change the scientific and scientific-industrial profile of their professional activities (OK-2);
- willingness to choose methods and develop algorithms for solving problems of complex dynamic systems.

The finite element method in engineering
CODE - GEN160
CREDIT – 6 (1/1/1/3)
PREREQUISITE-Mathematics I, II. Physics I. Statics and strength of materials. Solid state mechanics

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PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of the course is to Introduce students to the methodology of performing finite element analysis in the Structure3D workstation environment. Mastering the theoretical concepts of FEM and its practical application in the Structure3D workstation. Mastering the creation of an object model, both directly in the APM Strucmrc3D editor, and using the three-dimensional APM Studio editor; methods for splitting the model into finite elements, calculating the constructed model and analyzing the results of calculations.

Task of the course.

- gain knowledge for conducting a comprehensive engineering analysis of the designed objects with the help of modern software tools and making competent design decisions based on it;
- master methods for studying the stress-strain state of models of designed structures, their dynamic characteristics and stability characteristics under constant and variable external loading modes;
- master the finite element method (FEM) and its use with the arm Structure3D, a three-dimensional editor of the arm Studio

BRIEF DESCRIPTION OF THE COURSE

The main concept of FEM. Types of finite elements. Discretization. General concepts of computer-aided design. Creating a computational model of the rod structure. Creating and calculating a rod-plate model of the structure. Create and calculate models of structures containing lamellar and three-dimensional finite elements in the editor of the module APM STRUCTURE 3D. Using the 3D preprocessor APM STUDIO to create, load, and generate a finite element grid of three-dimensional models.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

In accordance with the objectives of teaching, students should:

have an understanding of:

- modern methods of designing mechanisms, machines and the mechanical part

of apparatuses, including computer-aided design (CAD) systems);

- on the current state of the problem and methods of studying the stress-strain state of solid elastic bodies;

be able to:

- select the type of finite elements (for the entire model or its individual parts) that will be used to adequately model the real design;
- build a model of the projected object in three-dimensional space;
- split the model into finite elements;
- perform the full range of necessary calculations;
- visualize the results obtained and correctly interpret them in order to make the right design decisions.

acquire practical skills:

- performing finite element analysis in the APM Structure3D workstation environment;
- automated calculation and design of machine parts, mechanisms, structural elements and components in the APM WinMachine automated control system;

Thermal System Design

CODE – GEN169

CREDITS – 6 (1/2/0/3)

PREREQUISITE – Mathematics I, II. Physics I. Numerical Methods & Programming

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COURSE GOALS AND OBJECTIVES

Students gain knowledge in the field of design of thermal systems. The main goal is to teach students to carry out engineering calculations for the selection of thermal systems, the selection of components for thermal systems, heat exchangers, pumping power, and other components. As part of the design, students will be able to draw up a technical-economical study for thermal systems. To be able to carry out calculations of energy efficiency and thermal performance of thermal systems. Conduct economic calculations of the profitability of using a particular thermal system. Conduct the first and second law thermodynamic analysis to determine the efficiency of the system. Optimization calculations of thermal systems. The main objective of the course is the formation of knowledge on the design and determination of energy efficient, environmentally friendly and economically viable thermal systems. The course provides modern HVAC technologies based on renewable energy sources.

COURSE BRIEF DESCRIPTION

The course is based on the book "Design of Thermal Systems" by W.F. Stoecker. Engineering design. Working systems design. Economic calculations for engineering systems. Thermal systems modeling. System modeling of thermal installations. Optimization of heating systems. Mathematical modeling-thermodynamic parameters. Dynamic behavior of thermal systems. Modeling using methods of probability theory. Solar heating and hot water supply. Heating systems based on renewable electricity.

KNOWLEDGE & SKILLS AFTER THE COURSE COMPLITION

Student should know:

- design of thermal systems;
- calculation and selection of heat exchangers;
- calculation and selection of electrical equipment for heating systems;
- system modeling;
- heat balance equation; programming languages: such as Fortran, C ++, Python
- programming languages: such as Fortran, C ++, Python;

should be able to:

- use modern computer technologies and software for the calculation and selection of thermal systems;
- use TRNSYS and EES software in the calculation and selection of accessories for thermal systems;
- apply mathematical methods in system modeling of thermal installations.

should have skills:

- work with computer software;
- analytical and numerical solution of various engineering problems;
- applying the acquired knowledge for calculations in engineering.

Statistical mechanics
CODE-GEN167
CREDIT – 6 (2/1/0/3)
PREREQUISITE-Mathematics I, II. Ordinary differential equations. Physics I.

PURPOSE AND OBJECTIVES OF THE COURSE

Formation of students ' scientific bases of probabilistic approach to calculations of structural elements for strength, reliability, stability. Study of the basics of statistical mechanics and reliability theory and practical methods of their application. Preparation for the possible use of the above methods in the practice of designing and developing devices, machines and structures in various fields of industry. Development of students ' logical thinking, skills of independent thinking, necessary in further work and study of the basics of the theory of random processes.

BRIEF DESCRIPTION OF THE COURSE

This course covers the issues of determining the probabilistic characteristics of processes, mastering statistical methods for calculating systems, the main provisions of the theory of random processes, methods for analyzing random vibrations of mechanical systems, drawing up mathematical models for calculating machine elements, mechanisms and machine units under the action of random loads, performing calculations of reliability and trouble-free operation of systems, methods for calculating strength reliability and fatigue durability.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

As a result of studying the discipline, the student should
know:

- the main provisions of statistical mechanics for assessing the reliability, durability and resource of machines, devices and equipment;
- basic laws of dynamic processes arising in mechanical systems;
- mathematical methods for solving problems.

be able to:

- determine the probabilistic characteristics of the generalized coordinates of the system and their derivatives for systems with a finite number of degrees of freedom;
- determine the probability of failure-free operation of mechanical systems;
- solve problems about emissions from random fluctuations;

- formulate your own conclusions and justify them.

have the skills:

- solutions of differential equations of forced random oscillations of linear systems and oscillations caused by random kinematic excitation;
- performing calculations of reliability and uptime of systems;
- analysis of the received decisions and their independent interpretation;
- develop and deepen your own knowledge.

have the following competencies:

- willingness to apply practical methods of the fundamentals of statistical mechanics and reliability theory;
- ability and willingness to use the studied material in their subject area;
- willingness to use information technology to solve statistical mechanics problems;
- willingness to analyze the results and summarize them;
- willingness to work not only independently and independently, but also in a team.
- f input data for the design of equipment elements and activities in General with the use of regulatory documentation and modern methods of searching and processing information.

Lab Course: Fluid Flows
CODE – GEN161
CREDIT – 3 (0/2/1)
PREREQUISIT - Mathematics I, II, III. Physics I, II, Dynamic, Fluid Mechanics.

PURPOSE AND OBJECTIVES OF THE COURSE

Purpose of the course: Formation of students' knowledge of the methods and techniques of experimental research; verification and consolidation of the knowledge gained within the discipline of fluid mechanics through experiments.

Objectives of the course:

- transfer the basics on the experimental research methodology;
- explain and demonstrate the principles of the instrumentation (pressure gauges, anemometers, thermometers, etc.);
- teach the methodology for measuring and calculating the main flow parameters (pressure, velocity, etc.);
- to form students' skills of conducting experiment and teaching and to summarize experimental results.

SHORT DESCRIPTION OF THE COURSE

Lab course "Fluid flow" is aimed at consolidating the theoretical knowledge gained on the Fluid mechanics and developing students' skills in conducting experimental research.

KNOWLEDGE, ABILITY, SKILLS AFTER COMPLETION OF THE COURSE

As a result of mastering the discipline, students should
know:
- principles of measuring equipment operation;
- methodology and procedure for conducting experimental research;
- methods of collecting and processing experimental data.

Be able:
- apply basic theoretical knowledge to explain the obtained experimental results;
- distinguish between fluid flow regimes and methods for solving problems on fluid movement;
- independently conduct experimental research

владеть навыками:
- independent work with educational and scientific literature;
- collecting, processing experimental data and explaining the results obtained using

theoretical basis;

- application of theory to explain the experimental results.

Defense of the thesis / thesis project
CODE –
CREDIT – 4
PREREQUISITE – no

PURPOSE AND OBJECTIVES OF THE COURSE

This course is intended for the systematization and implementation of the thesis. The purpose of the thesis (project) is:
1) systematization, consolidation and expansion of theoretical knowledge and practical skills in the specialty and their application in solving specific scientific, technical, economic and industrial problems, as well as cultural tasks; 2) development of independent work skills and mastering the methodology of scientific research and experimentation in solving the developed problems and issues; 3) finding out the student's readiness for independent work in the conditions of modern production, science, technology, culture, as well as the level of his professional competence.

BRIEF DESCRIPTION OF THE COURSE

This course is designed to reveal the necessary basic concepts, understanding the current problems of the scientific field in which the thesis is being performed. A thesis (project) is a written final work that is performed at the final stage of training, if this is provided for by the state mandatory standard of education and the curriculum of the specialty.
The thesis (project) is a generalization of the results of independent study and research of the actual problem of a specific specialty of the corresponding branch of science.
The thesis (project) is carried out under the supervision of the supervisor and must meet one of the following requirements:
1) summarize the results of research, design decisions made by scientists, analysts, practitioners: engineers, designers, managers, economists; 2) contain scientifically based theoretical conclusions on the object under study; 3) contain scientifically based results, the use of which provides a solution to a specific problem.
Students who have successfully mastered the master's thesis (project) are allowed to participate in the project theoretical bachelor's degree course in the amount of at least 240 credits.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

Upon completion of the course, the student develops basic knowledge in the scientific field of the field of study, skills in applying the studied methods of research of materials, methods of analysis and processing of experimental and literary information, as well as the ability to systematize and present data.