Name of subject	Applied Mechanics (ECTS 4)
Subject/module code	NMEX1304
Science taught semester (s).	3rd semester
Responsible teacher	Khudayberdiev Abduaziz Abduvalaevich - candidate of technical sciences, associate professor
Education language	Uzbek
Study to the program connection	Compulsory
Training hours (this including independent education)	**Total hours-120.** **Audience Training hours - 48.** Lecture hours - 24 Laboratory hours - 12 Practical hours - 12 **Independent education -72 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching science.** The purpose of teaching science is to prepare technically qualified specialists for the great future of Uzbekistan. For this, students are required to be trained as specialists who have mastered the modules of theoretical mechanics, resistance of materials, theory of machines and mechanisms, and machine details of the discipline "Technical Mechanics", have design potential, and are able to solve problems in any situation in production. **The task of** science is to instill in students the role and importance of science in human life and society by providing them with theoretical knowledge, practical skills, a methodological approach to production processes, and a scientific worldview. **Learning outcomes:** - Finding the center of gravity of a rigid body under the influence of arbitrary systems of forces located in different planes and spaces; - Having an idea and knowledge of the forms of motion of a rigid body in mechanical motion, the laws of motion of mechanical systems taking into account changes in the environment, the basic laws and principles of dynamics, differential equations of motion of mechanical systems, general theorems of rigid body dynamics, internal forces arising in structural elements, stresses and deformations arising in simple types of deformation, calculation schemes of buildings and structures and their kinematic analysis, the theory of influence lines, displacements arising in elastic systems, statics and methods of calculating uncertain systems; - To correctly select the calculation formulas of the science, calculation models of construction structures, determine internal forces and deformations in construction elements, select the calculation scheme of buildings and structures and their kinematic analysis when solving theoretical foundations and practical problems of the science; - To have the skills of calculating the theory of influence lines, statically definite and indefinite systems, under fixed and moving loads; - To have experience in using and applying them in general engineering and specialized disciplines, in completing coursework and projects, graduation qualification works, as well as in production, when performing engineering tasks.
Course content (topics)	**I. Main theoretical part (Lecture)** **Module I. Theoretical mechanics.** Topic 1. Introduction. Basic concepts. Basic axioms of statics. Connection reaction forces. System of forces intersecting at a point. Couple force and its moment. System of forces arbitrarily located in a

	plane and its moment. Principal vector and principal moment. **Topic 2.** Point kinematics. Methods of transmission of rigid body motion. Determination of velocities and accelerations, translational and rotational motion of a rigid body around a fixed axis. Basic concepts and laws of dynamics. **Module II. Resistance of materials.** **Topic 3.** Structural elements and their structures. Classification of forces. Loads. Types of deformation and deformation. Hypotheses. Stresses. Tensile and compressive deformation. Hooke's law. Poisson's ratio. Stress state. **Topic 4.** Geometric characteristics of flat cross-sections. Shear. Hooke's law in pure shear. Torsion. Basic concepts. Torsional moment. Torsional strength condition of a shaft. **Topic 5.** Bending. Bending moment, shear force and longitudinal force. Differential connections. **Topic 6.** Complex resistance. Basic concepts. Combined effect of bending with extension and bending with torsion. Priority. Critical force. Euler's formula. Calculation of thin-walled vessels under internal pressure. **Module III. Theory of machines and mechanisms.** **Topic 7.** The main types of mechanisms and classification of kinematic pairs. Determination of the degrees of freedom of mechanisms. The operability of machine parts and their maintenance. **Topic 8.** Design of machines. Structural materials used in industry and their selection. **Module IV. Machine details.** **Topic 9.** Transmissions. General concepts. Fundamentals of calculation and design of friction and variator transmissions. Belt transmissions. Transmission geometry and kinematics. Forces and stresses in a belt transmission. Slippage of the belt on pulleys. Chain transmissions. Transmission geometry and kinematics, fundamentals of its calculation and design. **Topic 10.** Gear transmissions. Transmission geometry and kinematics. Specific features of the geometry of a helical gear. Performance of gears and their wear. Geometry and kinematics of a bevel gear transmission. Forces and stresses in the coupling. Brief concept of the M.I. Novikov transmission. **Topic 11.** Worm gears. Transmission geometry and kinematics. Forces and stresses generated in a worm gear. Determination of the useful efficiency of the gear (F.I.K.) and checking its heating. Planetary and wave gears. Transmission kinematics. Calculation of planetary gears. Shafts and axles. Their calculation and design. Bearings and their selection. **Topic 12.** Joints. Non-separable joints and the basics of their calculation. Separable joints and the basics of their calculation. Couplings and their types. **II. Guidelines and recommendations for organizing laboratory exercises.** In laboratory classes, students develop practical skills and competencies in determining various parameters of mechanical analysis, conducting experiments, calculating and drawing tables and graphs. The proposed topics are selected based on opportunities and conditions. **Suggested topics for laboratory work:** 1. Tensile testing of carbon alloy steels and analysis of the elongation diagram. 2. Compression testing of carbon alloy steels and analysis of the elongation diagram. 3. Torsion testing of steel and cast iron samples.

4. Experimental verification of the bending theory on the example of testing freely lying beams on two supports.

5. Determination of kinematic parameters of gear mechanisms. Determination of the transmission ratio of planetary mechanisms.

Study of the structure of closed cylindrical, conical, worm gears (reducers) and determination of their parameters.

Study of the structure and design of bearings.

Study of the structure of a chain (belt) transmission, determination of geometric and kinematic parameters**.**

III. Instructions and recommendations for practical training

Practical training should be conducted in an auditorium equipped with multimedia devices by one professor per academic group. It is advisable that the training be conducted using active and interactive methods, and appropriate pedagogical and information technologies should be used.

Recommended practice topics:

1. Determination of the support reactions of a rigid body. Point kinematics. Methods of transmission of rigid body motion. Determination of velocities and accelerations.

2. Basic problems of dynamics. Methods of determining the laws of dynamic motion of a material point.

3. Stresses. Tensile and compressive deformation. Hooke's law. Static indeterminate problems in tensile and compressive deformation.

4. Determination of the geometric characteristics of flat cross-sectional surfaces. Torsion. Basic concept. Torsional moment. Condition of shaft strength in torsion.

5. Bending. Bending moment, shear force and longitudinal force. Differential connections.

6. Complex resistance. Basic concepts. The combined effect of tension with compression and bending with torsion.

7. Calculation of thin-walled pipes under the influence of internal and external symmetrical pressure.Silindrik rezervuarlar hisobi.

8. Calculation of gas cylinders under pressure.

9. Kinematic calculation of the drive and selection of electric motors.

10. Transmissions. Friction transmissions and variators.

11. Fundamentals of calculation and design of friction and variator transmissions.

12. Belt drives. Transmission geometry and kinematics.

13. Forces and stresses in a belt drive. Slippage of a belt on a pulley.

14. Chain drives. Transmission geometry and kinematics. Fundamentals of its calculation and design.

15. Gear drives. Transmission geometry and kinematics. Specific features of the geometry of a helical gear.

16. Performance of gears and their wear. Forces and stresses in a spur gear with a cylindrical gear.

17. Geometry and kinematics of a bevel gear. Forces and stresses in the coupling. Brief information about the M.I. Novikov gear.

18. Worm drives. Transmission geometry and kinematics.

19. Forces and stresses generated in a worm gear. Determination of the useful coefficient of performance (F.I.K) of the transmission and checking its heating.

20. Planetary and wave-shaped transmissions. Transmission kinematics. Calculation of planetary transmissions. Shafts and axles. Their calculation and design;

21. Connections. Non-separable connections and the basics of their calculation. Separable connections and the basics of their calculation.

Recommended computational and graphic work topics:

1. Task. Determination of the support reaction forces of a rigid body.

	2. Task. Calculation of the strength of a statically accurate multi-stage rod. **3. Task.** Calculation of the strength of beams working in bending. **IV. Independent study and independent work.** The student's independent work in this academic discipline includes working with the text of lectures and recommended literature, preparing for laboratory work, computational and graphic work, and independent work. When organizing independent learning, it is recommended to use the following forms, taking into account the characteristics of the discipline: - studying chapters and topics of the subject according to textbooks and study guides; - mastering the lecture part according to lecture texts and handouts; - working with automated teaching and control systems; - in-depth study of sections and topics related to the student's educational, scientific and research work; - organizing training sessions using active and problem-based teaching methods; - distance learning. **Independent study for recommended topics:** - The role of science in the mechanical engineering of Uzbekistan and the history of its development. History of the science of mechanics. - Moment of force about a point and an axis. The relationship between the moment of force about an axis and the moment about a point lying on this axis. Couple force. Theorem on the moment of a couple of forces. Determination of the moment of a couple of forces. - Determination of the support reactions of a rigid body. - Determination of velocities and accelerations depending on the law of motion. - Velocities and accelerations in the translational and rotational motions of a rigid body around a fixed axis. - Two main problems of dynamics. - Integrating the differential equations of motion of a rigid body under the influence of constant forces. - Theorem on the change in the amount of momentum. Theorem on the change in kinetic momentum. - Internal forces and their determination by the method of intersection. - Taking into account specific gravity when solving problems related to tension and compression. - Temperature and assembly (assembly) stresses - Calculation of rods for strength. - Linear, plane and volumetric stress states. - Stresses on curved surfaces. Generalized Hooke's law. - Static indeterminate problems for tension and compression and methods for solving them. - Understanding the basic geometric characteristics of flat shapes. - Determining the moments of inertia and moments of resistance of simple shapes. - Changes in moments of inertia when the axes are moved parallel and rotated by a certain angle. - Pure displacement. Hooke's law for pure displacement. - The relationship between the modulus of elasticity and Poisson's ratio. - Hooke's law for torsion. Calculation of the strength and stiffness of shafts with circular cross-section. - Construction of bending moment, shear force and distributed force diagrams. - Calculation of redundant links in the structural analysis of

	mechanisms. - Kinematic analysis of sliding mechanisms. - Analysis of the kinematics of mechanisms. - Kinetostatic calculation of the two-stage Assur group. - Determination of the transmission ratios of differential mechanisms. - Synthesis of lever mechanisms. - Adhesive and friction-based connections and their calculation. - Friction and wear in machine parts. - Lubricants for machine parts. - Cylindrical gears with chevron teeth. - Bevel gears with bevel and circular teeth. - Screw and hypoid gears with a cross-axis. - Multi-ply belt gears. - Multi-row chain gears. - Calculation of couplings. - Mechanisms of lifting and transporting machines.
Student assessment	Assessment of student knowledge is based on the mastery of the teaching material during the semester and final control (tests, assignments, written and oral work results). During the course of Practical Mechanics, students are evaluated on a 100-point system. Of these, 50 points are allocated to the current and intermediate results (60% of the 50 points are current control, independent study and 40% are intermediate control), and 50 points are allocated to the final control result. Students whose total score of current and intermediate points is less than 30 points are not admitted to the final control exam. A student who scores 30 or more points in the final control is considered to have mastered the subject.
Requirements for exams	The student must have fully mastered the theoretical and practical concepts of the subject, be able to correctly reflect the results of the analysis. The student must have completed the tasks assigned in the current and intermediate forms of independent work, assessment. At the same time, he must have received the necessary points from the current, intermediate, independent education and final tests in the relevant subject within the specified time. A student who has not submitted current control, intermediate control and independent education tasks, as well as who has scored less than 30 points on these tasks and types of control, is not included in the final type of control. Also, a student who has missed 25 or more percent of the classroom hours allocated to the subject without an excuse is excluded from this subject, is not allowed to take the final exam and is considered not to have mastered the relevant credits in this subject. A student who fails a final exam or scores between "0-29.9" on this type of exam is considered an academic delinquent.
Recommended Literature	**Main literature:** 1. Ferdinand P. Beer., E. Russell Johnston. Jr., John T. DeWolf., David F. Mazurek. Mechanics of materials – USA 2015. 2. Ambedkar A.G. Mechanism and Machine Theory. India. 2009. 3. Richard G. Budynas., J. Keith Nisbett. Shigley's mechanical engineering design. Published by McGraw-Hill Education 2. Penn Plaza. New York, 2015. 4. V.I. to Szol. Theoretical mechanics. Berlin. part-1. 2013. 5. Mirsaidov M.M., Boymurodova L.I., Giyasova N.T. Theoretical mechanics. Study guide.T. Uzbekistan. 2008. 6. Meshchersky I.V. A collection of problems from theoretical mechanics. Study guide .T. Teacher, 1990. 7. Anorkulov T., Khusanov K., Komiljonov A. Collection of assignments

for coursework in theoretical mechanics. T. Ziyo-nashr. 2002.

8. Karimov R.I., Saliev A. Textbook on the theory of mechanisms and machines. T. TashDTU. 2006.
9. Abduvaliev U.A., Karimov R.I. Applied mechanics. Department of the theory of machines and mechanisms. Textbook. T. TashDTU. 2008.
10. K.A. Karimov., Kh.N. Khabibullayeva. Application of the theorem on the change in kinetic energy of the system in the study of the motion of a mechanical system. Methodological guide. T. TDTU, 2013.
11. J.R. Turmatov., N.N. Narbekov, Technical mechanics. Textbook. JizPI. 2022.
12. A.A. Khudaiberdiev. Technical mechanics. Textbook. JizPI. 2022.
13. A.A. Khudaiberdiev. Technical mechanics. Textbook. JizPI. 2022.
14.A.A.Khudayberdiev., G.G.Egamnazarov. Applied mechanics. Textbook. JizPI. 2023.

Additional literature:

1. Mirziyoyev Sh.M. Critical analysis, strict discipline and personal responsibility should be the daily rule of every leader. Speech of the President of the Republic of Uzbekistan at the meeting of the Cabinet of Ministers of the Republic of Uzbekistan dedicated to the results of 2016 and prospects for 2017. //"Xalq so'zi" newspaper. 2017. January 16, No. 11.
2. On the Strategy of Actions for the Further Development of the Republic of Uzbekistan. T. Decree of February 7, 2017, No. PF-4947.
3. Ergashov M. “Calculation of the Resistance of Materials - Design Work”. Textbook. Tashkent. Uzbekistan. 2003.
4. Djuraev A and b. Theory of Mechanisms and Machines. Textbook. T. Teacher. 2004.
5. N.N.Narbekov. Mechanics (resistance of materials). Textbook. JizPI. 2022.
6. Constitution of the Republic of Uzbekistan. T. Uzbekistan, 2017.

Information sources

1. www.gov.uz – Government portal of the Republic of Uzbekistan.
2. www.lex.uz – National database of legislative documents of the Republic of Uzbekistan.
3. www.ilm.uz.
4. www.ziyo.net.
5. http://www.ziyo.net
6. http://www.detalmash.ru
7. http://www.bmstu.ru
8. http://www.mashmex.ru
9. http://www.books.google.ru
10. http://www.isopramat.ru/tmm/literatura/artobolevskij-i-i-teoria-mexanizmov-i-mashin
11. http://www.detalmash.ru.