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
Connection to the curriculum	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.
Exam form	Written
Teaching/learning and examination requirements	Complete mastery of theoretical and methodological concepts and practical knowledge of the discipline, the ability to correctly reflect the results of analysis, independently reason about the processes being studied and carry out tasks in the current, intermediate forms of control and independent work, pass written work on the final control. When drawing up final exam questions, deviations from the content of the discipline program are not allowed. The bank of final exam questions for each discipline is discussed at the meeting and approved by the head of the department. No later than 1 week before the start of the final control, tickets signed by the head of the department, enclosed in an envelope, are sealed by the Dean's office and opened 5 minutes before the start of the exam in the presence of students. Final exam duration is 80 minutes. Answers to final exam questions are recorded in copybooks with the seal of the Dean's office. After completion of the final work, the work is immediately encrypted by a representative of the Dean's office, and the copybooks are handed over to the commission for verification. From the moment of completion of the final exam, a period of 72 hours is allotted for checking and posting the results on the electronic platform. The teacher who taught the students in this discipline is not involved in the process of conducting the exam and checking the students' answers. Student(s) who are dissatisfied with the final exam results may submit a written or oral appeal within 24 hours of the publication of the final exam results. Complaints submitted after 24 hours from the publication of the final exam results will not be accepted.
Scope of assessment criteria and procedure	CURRENT CONTROL Purpose: Determining and assessing the student's level of knowledge, practical skills, and competencies on course topics. Instructions: The student's activity in daily classes is assessed through the student's mastery of course topics, as well as constructively interpreting and analyzing the educational material, developing module-specific skills, acquiring practical skills (in terms of quality and the specified number) and competencies, solving problem situations aimed at applying professional practical skills, working in a team, preparing presentations, etc. Current control form: Activity in lessons Preparing educational materials Working with sources within the subject Using educational technologies Working in a team Preparing presentations Working with projects. MIDTERM CONTROL

Purpose: Assessing the student's knowledge and practical skills and level of mastery of lecture material after completing the relevant section of the course.

Form and procedure of intermediate control: Midterm examination is held during the semester during the training sessions after the completion of the relevant module of the curriculum of the subject. Midterm examination is held once in written form within the framework of this subject. Midterm examination questions cover all topics of the subject.

INDEPENDENT LEARNING

Purpose: Independent learning is aimed at fully covering the content of this course, expanding the theoretical knowledge acquired, and establishing independent learning activities for students.

Form and procedure of independent education: independent work assignments are completed in the form of an educational project, presentation, case study, problem solving, information search, digest, colloquium, essay, article, abstract, etc. Completed assignments for independent study are placed in the electronic system and checked based on the anti-plagiarism program and evaluated by the subject teacher.

In this case, the uniqueness of the completed assignment should not be less than 60%, otherwise the assignment will not be accepted for assessment. The number of independent work assignments, depending on the nature of the subject, should not be less than 3 for one subject (module). Independent work assignments account for 60% of the points allocated for current and intermediate control.

FINAL CONTROL

Purpose: The final examination is held at the end of the semester to determine the level of mastery of the student's theoretical knowledge and practical skills in the relevant subject. The final examination is held at a specified time according to the examination schedule created by the Registrar's Office on the electronic platform.

Requirements: The student must have passed the current control, intermediate control and independent learning assignments by the deadline for the final control type in the relevant subject. A student who has not passed the current control, intermediate control and independent learning assignments, as well as who has received a score in the range of "0-29.9" for these assignments and control types, is not included in the final control type. Also, a student who has missed 25 percent or more of the classroom hours allocated to a subject without a reason is excluded from this subject and is not included in the final control type and is considered not to have mastered the relevant credits in this subject. A student who has not passed or was not included in the final control type and has received a score in the range of "0-29.9" for this type of control is considered to be an academic debtor.

Final control form: The final examination in this subject will be conducted in written form. If the final examination is conducted in written form, the requirements for assessment must also be reflected.

Criteria for assessing student knowledge

5 grade	100 points		Assessment criteria
5	90-100	Excellent	When a student is considered to be able to make independent conclusions and decisions, think creatively, observe independently, apply the knowledge he has gained in practice, understand, know, express, and narrate the essence of the subject, and have an idea about the subject.
4	70-89,9	Good	When the student is considered to be able to observe independently, apply the knowledge he has gained in

			practice, understand, know, express, and narrate the essence of the subject, and has an idea about the subject.
3	60-69,9	Satisfactory	When the student is found to be able to apply the knowledge he has gained in practice, understands, knows, can express, and narrate the essence of the subject, and has an idea about the subject.
2	0-59,9	Unsatisfactory	When it is determined that the student has not mastered the science program, does not understand the essence of the subject, and does not have an idea about the science.

Course assessment criteria and procedure

Assessment type	Total points allocated	Control (task) form	Distribution of points	Qualifying score
Current assessment	30 points	System tasks	20 points (divided by the number of tasks)	18 points
		Student activity (in seminars, practical, laboratory classes)	10 points	
Midterm assessment	20 points	Supervision: Written work	10 points	12 points
		System tasks	10 points (divided by the number of tasks)	
Final assessment	50 points	Written assignment (5 questions)	50 points (10 points per question)	30 points

* Note: 60% of the points allocated for current and intermediate control are allocated to independent work assignments. Independent work assignments are evaluated as system assignments through the electronic platform.

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.