REPUBLIC OF UZBEKISTAN

MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATIONS

FERGANA STATE TECHNICAL UNIVERSITY

Theoretical mechanics

MODULE HANDBOOK

Field of knowledge:	700000	- Engineering and construction industries
Field of Education:	730 000	- Architecture and construction
Educational Program:	60730300	Civil Engineering

Fergana 2025

Module title	***Theoretical mechanics***
Code (if available)	*ApplMechM34*
Semester(s) of module teaching	*3*
Responsible for the module	*Sabirjonov Tolibjon Mamasoliyevich, Department of Applied Mechanics, Ph.D., Associate Professor* *Gaparov Kodirjon Gulomovich, Department of Applied Mechanics, PhD Senior Teacher*
Language of instruction	*Uzbek, Russian*
Connection to the curriculum	*Compulsory*
Teaching methods	*lecture, practical training, independent study.*
Study load (including classroom and independent study hours)	*Total hours: 120 hours* *Auditorium hours: 44 hours* *lecture – 24 hours, practical training-20 hours, Independent study – 48 hours.*
Credit units	***4***
Required and recommended prior knowledge for studying the module	*Physics, Higher mathematics*
Module objectives/intended learning outcomes	***The purpose of the module:*** *the purpose of teaching students science is to teach the equilibrium state of solids, the General Laws of mechanical motion, the movement of material points and solids, the assessment of dynamic motion influenced by forces, and methods of solving related issues. To achieve the above goal, science consists in teaching students the formulas and methods of calculating the basic principles and laws of general mechanics, which are passed for theoretical knowledge, practical skills, various undergraduate areas of Architecture and construction, as well as solving some practical issues.* • *The following requirements are placed on students' knowledge, skills and competencies in the subject. Student: the skill of deep understanding of the laws of movement and balance, the influence of forces and the concepts of dynamics develops, the skill of performing practical calculations on statics, kinematics and dynamics is formed, the ability to analyze the stability and strength of building structures and systems increases, in the process of designing structures, mechanics develop the skill, This creates an opportunity to effectively use the knowledge of theoretical mechanics in the construction industry. In the kinematics part, one can study the movement of an object or point from a geometric point of view, that is, without taking into account the cause (force and mass) that drives them, and know the methods of determining them and be able to use them.* • *In the part of the dynamics, the movement of the body and the material point is studied taking into account the cause that causes this movement to occur.*
Content	***Module 1.*** *Introduction to the science of theoretical mechanics. Basic concepts and axioms of Statics: the role of theoretical mechanics in its composition, tasks and production. Subject, basic concepts and axioms of Statics. Bond and bond reaction forces. System of intersecting forces. Geometric and*

	analytic addition of forces. Balance of intersecting forces. Theorem on three forces. ***Module 2.*** *Intersecting and parallel forces. Double strength. Force moment: geometric and analytic addition of a system of intersecting forces at a point. Projection of force on the axis and plane. Theorem on the balance of three forces. Equilibrium conditions of the system of intersecting forces. Moment of force relative to point and Axis. Paired forces. Moment of paired forces.* ***Module 3.*** *System of forces located in the plane: the moment of force relative to the point and Axis. A pair of forces and its moment. Adding even forces. Equilibrium of the system of paired forces. Head vector and head moment of forces located in the plane. Balance of flat bodies.* ***Module 4.*** *Balance of bodies affected by friction force: sliding and rolling friction forces. Module 4. Balance of bodies affected by friction force: sliding and rolling friction forces. Balance and movement of machines and mechanisms affected by friction force.* ***Module 5.*** *The center of gravity of the bodies. Determination of equal influencers of Parallel forces. Center of Parallel forces. Methods for determining the center of mass of a body: division into parts, symmetry, integral formula, negative surfaces, and experimental methods.* ***Module 6.*** *Equilibrium of spatial bodies: projections of spatial force on coordinate axes. moments of spatial force relative to coordinate axes and coordinate head.* ***Module 7.*** *Point kinematics: basic concepts and tasks of kinematics. Methods of giving the movement of the material point. Speed and acceleration of the point. Types of movement of machines and mechanisms.* ***Module 8.*** *The simplest movements of a solid. Circular movements of the solid around the advancing and unshakable axis. Velocities and accelerations of solid points. Angular velocities and accelerations of an object in circular motion. Circular movements of the parts of the machine and mechanisms around the advancing and non-driving axis.* ***Module 9.*** *Complex movements of a material point and a rigid body: the complex movement of a material point. The division of complex motion into relative, relational, and absolute motion. Coriolis acceleration. Speed and acceleration of a point in complex motion.* ***Module 10****. Material point dynamics: basic concepts and laws of dynamics. Types of forces in dynamics. Differential equations of motion of a material point. Two main issues of dynamics. Dynamic analysis of the movement of parts of a construction structure.* ***Module 11.*** *Linear oscillatory movements of a material point: the free, fading and forced oscillatory movement of a material point. Frequency of oscillation, amplitude, period and attenuation decrement. Resonance phenomenon and measures to pass through it. Vibration movement of parts of construction structures.* ***Module 12.*** *Introduction to mechanical system dynamics. Moment of inertia. Mechanical system mass and center of mass.*

	Class of forces acting on a mechanical system. Properties of internal forces. Moment of inertia. Moment of inertia of homogeneous solids. Moments of inertia with respect to Parallel and intersecting axes. Centrifugal moments of inertia. Principal axes of inertia and principal moments. ***Module 13.*** *Dalamber principle. General equation of dynamics. Dalamber principle for point and mechanical system. Head vector and head moment of inertial forces. Dynamic reactions affecting the axis of a rotating body. Balancing rotating bodies. Link classification. Possible migrations. Degree of freedomheme 13. Dalamber principle. General equation of dynamics. Dalamber principle for point and mechanical system. Head vector and head moment of inertial forces. Dynamic reactions affecting the axis of a rotating body. Balancing rotating bodies. Link classification. Possible migrations. Degree of freedom. The principle of possible migrations.* ***Module 14.*** *LaGrange equations. Generalized coordinates and generalized velocities. Generalized forces, the equilibrium condition of the mechanical system in generalized coordinates, is Lagrange's equation.* ***Module 15.*** *Shock theory. The basic equation of shock theory. General theorems of shock theory. Recovery factor in shock.* ***Practical training*** *1. Solid statics.* *2. The bond and its reactions.* *3. Geometric and analytic addition of forces.eme 15. Shock theory. The basic equation of shock theory. General theorems of shock theory. Recovery factor in shock.* *Practical training* *1. Solid statics.* *2. The bond and its reactions.* *3. Geometric and analytic addition of forces.* *4. Constructions consisting of several bodies.* *5. Point kinematics: the simplest movements of a rigid body.* *6. The movement of a rigid body parallel to the plane.* *7. Material point dynamics. Two main issues of material point dynamics.* *8. The movement of the material point in the connection . The relative motion of the material point.* *9.Oscillatory motion of the material point.* *10. Recovery factor in shock*
Forms of assessment	oral, presentation, written work, practical assignments, and final exams.
Requirements for study and assessment	To successfully complete the module, the student must attend classes and achieve the minimum scores in the current, intermediate and final assessments.

Bibliography	1. M.M. Mirsaidov, T.M. Sobirjonov. Theoretical Mechanics. Fergana: “Klassik”, 2020. 277 pages. 2. Kenjayev K. "Theoretical Mechanics: Problems and Exercises, Part 1: Statics." Textbook. Tashkent: “Cholpon”, 2018. 304 pages. 3. Kenjayev K. "Theoretical Mechanics: Problems and Exercises, Part 2: Kinematics." Textbook. Tashkent: “Cholpon”, 2018. 279 pages. 4. Jianlin Liu. Lecture Notes on Theoretical Mechanics. Qingdao, Shandong, China: Metallurgical Industry Press, 2019. 152 pages. https://doi.org/10.1007/978-981-13-8035-8 5. Dimitrios Kolymbas. A Primer on Theoretical Soil Mechanics. Cambridge University Press, 2022. 188 pages. 6. V. S. Bondar, V. G. Ryabov, V. K. Petrov, G. I. Noritsyna. Theoretical Mechanics. Moscow: Lan’ Publishing House, 2020. 368 pages. 7. N. N. Polyakhov, P. E. Tovstik, S. A. Zegzhda, M. P. Yushkov. Theoretical and Applied Mechanics. St. Petersburg University Press, 2022. 548 pages. 8. T.M. Mavlanov et al. “Mechanics I — Solving Problems in Theoretical Mechanics Using Mathcad Software.” Textbook. Tashkent: TTESI, 2012. 156 pages. 9. M.M. Mirsaidov, T.M. Mavlanov. “Mechanics I — Explanatory Dictionary on Theoretical Mechanics.” Textbook. Tashkent: TIMI, 2015. 56 pages. 10. R. C. Hibbeler. Engineering Mechanics: Statics & Dynamics. Twelfth Edition. Pearson, 2016. 11. G.O. Anischenko, D.V. Lavinsky. Theoretical Mechanics. Kharkiv: NTU “KhPI”, 2019. 120 pages. 12. T.V. Ignatyeva, D.A. Ignatyev. Theoretical Mechanics. Saratov: Publishing House “Higher Education”, 2018. 101 pages.
Reviewers	*M.M.Mirsaidov – TIQXMMI Phd(Technical Sciences), Professor “Head of the Department of Theoretical and Structural Mechanics.* *A.D.Dusmatov – Phd(Technical Sciences), Associate Professor, Department of "Construction of Buildings and Structures",*