SYLLABUS OF THE COURSE

TECHNICAL MECHANICS

Educational Level	First (bachelor)
Academic program	"Electrical energetics, electrical engineering and electromechanics"
Teaching time	4th semester (7,8 quarters)
Lectures (hours/week)	2 hours (7 and 8 quarters.)
Practical Classes (hours/week)	1 hour (7 quarter), 2 hours(8 quarter)
FinalCcontrol	Exam
Teaching Language	English

Site Page	https://do.nmu.org.ua/course/view.php?id=2070
Teaching Department	Structural, Theoretical and Applied Mechanics

Professor:

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1. Annotation

Technical Mechanics is one of the general scientific disciplines, on the conclusions of which the knowledge necessary for mastering a number of sections of special and general engineering disciplines is based.

The Technical Mechanics study provides knowledge for understanding the mechanical phenomena that will be encountered by future professionals in practice, as well as for self-mastery of new technologies that arise at the boundaries of various branches of technical sciences. The course of Technical Mechanics contributes to the expansion of scientific horizons, and increases the general culture of the future specialist, the development of thinking and the development of his materialist worldview.

2. The purpose and objectives of the course

The purpose of the discipline is to form knowledge of general methods of using the basic laws and principles of Mechanics necessary for the analysis of physical phenomena, modeling of various processes and finding optimal solutions to problems arising in the development, technical implementation and operation of electromechanical and power equipment.

The task of the discipline: formation of theoretical knowledge and practical skills of future professionals in accordance with the goal; developing students' skills and abilities in solving practical problems, using the basic laws and methods of Technical Mechanics; providing skills and knowledge necessary for mastering the general competencies of the bachelor, which are regulated by the educational-professional pro»gram in the specialty 141 «Electric power, electrical engineering and electromechanics».

3. Learning Outcomes:

As a result of studying the discipline, the applicant of higher education has to **be able:**

- compose and resolve equilibrium equations for systems of forces, determine force factors and build their diagrams;
- compose and solve the equation of motion of material bodies;
- find the kinematic characteristics of the motion of solids;
- use general theorems and principles of dynamics for analysis, mechanical processes in machines and devices of electromechanical equipment;
- perform engineering calculations for strength, rigidity and stability in tension, compression, torsion and bending;
- apply the acquired knowledge for diagnostics and modeling of standard structures of machinery and mechanisms of electromechanical and power equipment.

4. Course Structure

Types and Topics of Training Sessions
Lectures
1. Basic concepts and axioms of statics 1.1. Subject of statics. Basic concepts and axioms 1.2. Constraints, their classification 1.3. Moment of a force relative to the pole and axis
2. Equilibrium conditions of force systems 2.1. Equivalent systems of forces 2.2. Reduction of an arbitrary system of forces to the simplest form 2.3. Center of parallel forces. Center of gravity. Methods of finding the center of gravity 2.4. Equilibrium conditions of particular cases of force systems
3. Kinematics of the point 3.1. The subject of kinematics. Space and time in classical mechanics 3.2. Determining the motion of a point, path 3.3. Determining velocity and acceleration of a point

4. The simplest movements of a rigid body 4.1. Translational motion of a rigid body 4.2. Rotation of a rigid body around a fixed axis. Angular velocity and angular acceleration of the body 4.3. Velocity and acceleration of points of a rotating solid
5. Plane motion of a rigid body 5.1. Equation of plane motion. Distribution of velocities of points of a plane figure. Velocity projection theorem 5.2. Determining velocities and accelerations of body points in plane motion 5.3. Instantaneous center of velocities and ways to find it. ICV as a pole. Methods for determining the angular velocity and angular acceleration of a plane figure
6. Dynamics of the point 6.1. The subject of dynamics. Laws of dynamics 6.2. Problems of point dynamics 6.3. Differential equations of the motion of a point
7. General theorems of dynamics 7.1. The concept of mechanical systems. Mass and geometric characteristics of systems and solids 7.2. Measures of mechanical motion of the system 7.3. Measures of mechanical interaction 7.4. Theorem of the center of mass motion of a mechanical system. The law of motion of the center of mass of the material system 7.5. Theorem of the change in the momentum and kinetic momentum of mechanical system. Equation of motion of a rigid body around a fixed axis 7.6. Theorem of the change in of kinetic energy
8. Fundamentals of the theory of oscillations 8.1. Types of point oscillations. Differential equations of point oscillations 8.2. Free oscillations 8.3. Forced oscillations Decrement oscillations. Resonance
9. Introduction to Strength of Materials 9.1. Basic hypotheses. Types of beam deformation 9.2. Stress and strain
10. Axial tension and compression 10.1 Deformation of tension and compression. Longitudinal forces and drawing their diagrams 10.2. Tension. Longitudinal and transverse deformations. Hooke's law 10.3. Mechanical characteristics of materials. Tension and compression diagrams. Dangerous stresses. Strength and working stress. Strength condition
11. Torsion 11.1. Determining torques and drawing their diagrams 11.2. Stress and strain at torsion of round cross section rods 11.3. Calculation of strength and rigidity

12. Straight transverse bending 12.1. Types of bent beams. Internal efforts at direct transverse bending and drawing their diagrams 12.2. Differential dependences at bending. Differential equation of the elastic line of the beam 12.3. Normal stress at pure bending. Calculation of beams on strength by normal stresses
13. Basics of machine parts 13.1. Belt and chain transmissions 13.2. Gears and worm gears 13.3. Shafts and axles 13.4. Bearings 13.5. Detachable and non-detachable connections 13.6. Couplings
Practical Classes
Equilibrium of concurrent force system
Equilibrium of coplanar force system
Point kinematics: determining path, velocity and acceleration of a point
Rotational motion of a rigid body around a fixed axis. Determining the speed and acceleration of the body points
Plane motion of a rigid body: determining velocities and acceleration points of the body
Solution of the first and second problems of point dynamics
Using the theorem of the center of mass motion of a mechanical system
Using the kinetic moment theorem of a point and a system
Using the theorem of the change in kinetic energy of a point and a system
Oscillatory motion of a material point: free, damping and forced oscillations
Calculation of tensile and compressive strength and rigidity
Calculations for torsional strength and rigidity
Diagrams of internal efforts for beams at bending
Calculations for the strength of transverse bending by normal stress
Fundamentals of calculation of mechanical gears
Shaft calculation and bearing selection

5. TOOLS, EQUIPMENT AND SOFTWARE

Technical teaching aids (laboratory equipment, personal computers, multimedia equipment).

Remote platform (Teams, Zoom).

6. Assessment system and requirements

6.1. The academic achievements of the students based on the study results of the course will be evaluated on the scale below

Scales for assessing the academic achievements of students of NTU«DP»

Rating	Institutional
90…100	Excellent
74…89	Good

60…73	Satisfactory
0…59	Fail

6.2. Practical classes are assessed by the results of the defense of individual homework. Each of the 3 tasks is assessed on a 20-point scale (ie the maximum amount of points for practical classes is 60).

6.3. The theoretical part is assessed by the results of passing at the end of each quarter of complex tasks. The maximum score for the theoretical part is 100 points.

6.4. The final grade for the course (on a 100-point scale) is defined as the arithmetic mean of two grades for each quarter:

$$ПО = \left(\frac{\frac{100}{60} СБ_{пз} \cdot 1 + СБ_{т} \cdot 2}{1+2} + \frac{\frac{100}{60} СБ_{пз} \cdot 2 + СБ_{т} \cdot 2}{2+2} \right) \Big/ 2,$$

where $СБ_{пз}$ - the sum of points for the practical part; $СБ_{т}$ - the sum of points for the theoretical part; 60 - the maximum amount of points for the performance and defense of individual tasks; 100 - the maximum number of points for the theoretical part.

6.5. Applicants for higher education can receive a final grade in the discipline on the basis of current assessment of knowledge, provided that the number of points scored in the current control in the theoretical part and practical classes will be at least 60 points.

7. Course Policy

7.1. Academic Integrity Policy

Academic integrity of higher education students is an important condition for mastering the results of training in the discipline and obtaining a satisfactory grade from the current and final tests. Academic integrity is based on condemnation of the practices of copying (writing with external sources other than those permitted for use), plagiarism (reproduction of published texts by other authors without attribution), fabrication (fabrication of data or facts used in the educational process). The policy on academic integrity is regulated by the Regulations on the system of prevention and detection of plagiarism at the National Technical University «Dnipro university of technology»
http://www.nmu.org.ua/ua/content/activity/us_documents/System_of_prevention_and_detection_of_plagiarism.p

In case of violation of academic integrity by the applicant (copying, plagiarism, fabrication), the work is evaluated unsatisfactorily and must be repeated. The teacher reserves the right to change the topic of the task.

7.2. Communication policy

Applicants for higher education must have activated university mail. All written questions to teachers regarding the course should be sent to the university e-mail.

7.3. Reassembly policy

Reassignment takes place with the permission of the dean's office if there are good reasons (for example, sick leave).

7.4 Evaluation Appeal Policy

If the applicant does not agree with the assessment of his knowledge, he may protest the assessment given by the teacher in the prescribed manner.

7.5. Attending classes.

For higher education students, full-time attendance is mandatory. Good reasons for not attending classes are illness, participation in university events, academic mobility, which must be documented. The applicant for higher education and the reasons for absence must notify the teacher either in person or through the headmaster.

For objective reasons (for example, international mobility) training can take place online in consultation with the course leader.

8 RECOMMENDED SOURCES OF INFORMATION

1. S. Targ. Theoretical Mechanics. A Short Course. – Moscow: Foreign Languages Publishing House, 1974. – 421 p.
2. N.M. Belyaev. Strength of Materials. – Moscow: Mir Publisher, 1979. –647 p.
3. Theoretical mechanics. Kinematics [Text]: Summary of lectures/ A.M.Dolgov. - D.: National Mining institute, 1992. - 39 p.
4. Elements of Strength of Materials. [Text]: Summary of lectures, Part 1/ Blokhin S.E., A.M. Dolgov. - D.: National Mining university, 1998. - 35 p.
5. Theoretical Mechanics. Statics [Text]: Summary of lectures/ A.M.Dolgov. - D.: National Mining university, 1998. - 37 p.
6. Theoretical Mechanics. Dynamics [Text]: Summary of lectures/ A.M.Dolgov. - D.: National Mining university, 2000. - 49 p.
7. Theoretical Mechanics. Dynamics [Text]: tutorial/ A.M.Dolgov. - D.: National Mining university, 2012. - 160 p.
8. Dolgov, A.M. Theoretical mechanics [electronic resource] : electronic textbook / A.M.Dolgov ; Ministry of Education and Science of Ukraine, National Mining University. – Dnipropetrovs'k : NMU, 2015. – 124 p.
9. O.M. Dolgov, D.L.Kolosov. Mechanics of Machines [Text]: Study Guide / A.M. Dolgov. – D.: NTU «Dnipro university of technology», 2020. – 64 p.

Information Resources:

https://do.nmu.org.ua/course/view.php?id=2592
https://do.nmu.org.ua/course/view.php?id=2425
https://do.nmu.org.ua/course/view.php?id=2070
https://btpm.nmu.org.ua/ua/vydav/metodichka.php
https://btpm.nmu.org.ua/ua/selfstudy/och.php