Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Department of Dynamics and Strength of Machines and Strength of Materials

Materials and constructions mechanics
Part I. General course

Work program of the discipline (Syllabus)

Details of the academic discipline

Level of higher education	***First (bachelor)***
Field of knowledge	***13 Mechanical engineering***
Specialty	***134 Aviation and aerospace technologies***
Educational program	***Aviation and aerospace technologies***
Status of the discipline	*Normative*
Form of study	*Full-time form of study*
Form of study	*2 course, spring*
The scope of the discipline	*90 hours*
Semester control / control measures	*test/modular control work*
Class schedule	*https://kpi.ua/#rozkladModal*
Language of instruction	*English*
Information about course leader / teachers	Lecturer: *PhD, Senior Lecturer, Olha Musiienko, (098)7123509, olga.musinko@gmail.com* Лабораторні: *PhD, Senior Lecturer, Olha Musiienko, (098)7123509, olga.musinko@gmail.com*
Course placement	https://campus.kpi.ua

Curriculum

1. Description of the discipline, its purpose, subject matter and learning outcomes

The scientific and technological development of society requires specialists to constantly improve and improve the quality of machines, structures and facilities. An important condition for solving this problem is the solution of issues related to the strength, stiffness and stability of structural elements, which is the basis for their reliable operation.

“Mechanics of Materials and Structures is an academic discipline that teaches methods for solving these problems. This is the most general discipline about the strength of machines and structures, without which a full-fledged professional training of an engineer of any specialty is impossible.

While studying the credit module, students learn the principles of stress-strain analysis of the body, master engineering methods for calculating rods and rod systems for strength and stiffness under the simplest types of loads, study the mechanical properties of basic structural materials and master methods for determining them under static load.

When studying the discipline “Mechanics of Materials and Structures”, students acquire a number of professional competencies that provide them with an appropriate level of qualification in their chosen specialty. Namely:

Professional competencies:

- the ability to assess the performance parameters of materials, structures and machines in operating conditions and find appropriate solutions to ensure a given level of reliability of structures and processes, including in the presence of some uncertainty;

- the ability to use analytical and numerical mathematical methods to solve problems of applied mechanics, in particular to carry out calculations for strength, endurance, stability, durability, stiffness in the process of static and dynamic loading in order to assess the reliability of parts and machine structures.

Program learning outcomes:

As a result of studying the discipline students should:

- be able to perform calculations on the strength, endurance, stability, durability, stiffness of machine parts;

- be able to assess the reliability of machine parts and structures in the process of static and dynamic loading.

2. Prerequisites and co-requisites of the course

The course "Mechanics of Materials and Structures" refers to general engineering disciplines. It is based in the theoretical part on such disciplines as "Higher Mathematics" and "Theoretical Mechanics", and in the experimental part on the disciplines "Physics" and "Materials Science". The knowledge gained by students in the course of studying this discipline is used in the further study of such courses as "Machine Parts", "Hoisting and Transport Machines", special disciplines such as "Theory of Elasticity", "Theory of Vibrations", "Theory of Plasticity", etc.

3. Content of the discipline

Section 1. Basic concepts, hypotheses and principles

Topic 1. Objectives and subject of the discipline "Mechanics of materials and structures". Basic models of material, body shape, loads, supports.

Topic 2. Model of strength reliability, main stages and principles of construction: real construction and its design scheme; basic hypotheses and principles of mechanics of materials and structures; internal forces and methods of their determination, diagrams of internal forces for rods, stresses, displacements, deformations; assessment of strength reliability of a deformed body and the concept of safety margin.

Section 2. Geometric characteristics of plane sections

Topic 3. Area, static moments of areas, moments of inertia. Determination of moments of inertia relative to parallel axes and when the coordinate axes are rotated. Educational materials and resources.

Topic 4. Principal axes and principal moments of inertia, their definition. Moments of inertia of simple and complex figures.

Section 3. Tension and compression of rods. mechanical characteristics of materials in pure tension and compression

Topic 5. Determination of stresses and strains in tension and compression. Potential energy of deformation of the rod in tension-compression.

Topic 6. Determination of the main mechanical characteristics of materials in tension and compression. Determination of permissible stresses.

Section 4. Calculations for strength and stiffness of rods in tension and compression

Topic 7. Conditions of strength and stiffness of rods in tension and compression.

Topic 8. Calculations of strength and stiffness of statically determined rods.

Topic 9. Calculations for strength and stiffness of statically indeterminate rods.

Section 5. Fundamentals of the theory of stress and strain

Topic 10. Stress state of a body at a point: stress tensor; principal axes and principal stresses; types of stress state; octahedral sites and octahedral stresses; largest tangential stresses; plane and linear stress state.

Topic 11. Deformed state of a body at a point: the relationship between displacements and deformations (Cauchy's equation); strain tensor; volumetric strain.

Topic 12: Generalized Hooke's law.

Topic 13. Potential strain energy in the general case of a stressed state.

Section 6. Strength criteria

Topic 14. The concept of strength criterion.

Topic 15: Theories of strength.

Section 7. Calculations for the strength of rods in shear and bending

Topic 16. Determination of shear stresses in a rod.

Topic 17. Practical calculations for shear and crushing.

Topic 18: Pure shear.

Section 8. Calculations for strength and stiffness of rods in pure torsion

Topic 19: Torsion of a round rod.

Topic 20: Torsion of rods of non-circular cross-section and thin-walled profile.

Topic 21. Potential deformation energy of a rod in torsion.

Topic 22. Calculation of helical cylindrical springs with small pitch.

Section 9. Calculations for strength and stiffness of rods in plane bending

Topic 23. Stresses in a straight bar in pure bending.

Topic 24. Tangential stresses in a bar in plane transverse bending.

Topic 25. Calculations for strength in plane transverse bending.

Topic 26. Bending of thin-walled profiles.

Topic 27. Calculations for stiffness in bending: displacements in rods in bending; differential equation of the elastic line of the rod; method of initial parameters.

Topic 28. Potential deformation energy of a rod in bending.

Training materials and resources

Basic literature

1. https://ela.kpi.ua/bitstream/123456789/57016/1/Navch_Posib_MMK_Chastyna_1_Prost e_navantazhennia.pdf
2. Писаренко Г.С. Опір матеріалів: підруч. / Г.С. Писаренко, О.Л. Квітка, Е.С. Уманський;За ред. Г.С. Писаренка. – 2-ге вид., допов. і перероб. – К.: Вища шк., 2004. – 655 с.*)
3. Заховайко О. П. Опір матеріалів: Розрахунки стержнів і стержневих систем при простихвидах навантажень [Електронний ресурс]: Навч. посіб. / О. П. Заховайко. – Київ : НТУУ

«КПІ», 2016. – 274 с. http://ela.kpi.ua/handle/123456789/14494
4. Збірник задач з опору матеріалів: Навч. посіб. / М.І. Бобир, А.Є. Бабенко, О.О. Боронкота ін.; За ред. М.І. Бобиря. – К.: Вища шк., 2008. – 399 с.: іл. *)

Additional literature

5. Збірник задач з опору матеріалів [Електронний ресурс]: Навч. посіб. / М.І. Бобир, А.Є. Бабенко, О.О. Боронко та ін. – Київ : НТУУ «КПІ», 2012. – 570 с. http://ela.kpi.ua/handle/123456789/1885.
6. Заховайко О.П. Збірник конкурсних задач з опору матеріалів [Електронний ресурс]: Навч. посіб. / О.П. Заховайко, В.А. Колодежний, С.І. Трубачев. – Київ : НТУУ «КПІ», 2011. – 320с. http://ela.kpi.ua/handle/123456789/1007.
7. Методичні вказівки до виконання курсової і розрахунково-графічної робіт з дисципліни «Опір матеріалів» (завдання і приклади розрахунків) для студентів технічних напрямів підготовки усіх форм навчання/ Уклад.: А.Є. Бабенко, О.О. Боронко, Б.І. Ковальчук, С.М. Шукаєв, Г.Є. Візерська, О.П. Заховайко, С.І. Трубачев, В.А. Колодежний, А.М. Бабак. – К.: ІВК “Видавництво «Політехніка»”, 2010. – 108 с. http://mmi-dmm.kpi.ua/index.php/ua/materiali-3/metodichni-vkazivki.html
8. Приклади розв’язання типових задач з опору матеріалів: Метод. вказівки до викон. курс. роботи з дисц. “Опір матеріалів” для студ. техн. спец. Усіх форм навчання / Уклад.: Б.І. Ковальчук, С.М. Шукаєв, О.П. Заховайко, Д.Ю. Шпак. – К.: ІВЦ “Видавництво “Політехніка”, 2003. – Ч. І.- 68 с. http://mmi-dmm.kpi.ua/index.php/ua/materiali-3/metodichni-vkazivki.html.
9. Можаровський М.С. Теорія пружності, пластичності і повзучості: Підручник /М.С. Можаровський. – К.: Вища шк., 2002. – 308 с. *)

Educational content

4. Methods of mastering the discipline (educational component)

The course consists of lectures and laboratory classes, as well as independent study of individual issues. Lectures focus on the theoretical foundations of the discipline. Each lecture is preceded by information (by topic) on the current class and recommendations for studying them. Laboratory work and practical classes are aimed at deepening theoretical knowledge.

For the successful completion of the course, it is necessary to provide for a close interconnection of all types of classes - lectures, practical and individual. The theoretical material presented in lectures is the basis for solving engineering problems performed in practical and laboratory classes and during individual independent tasks. This allows you to deepen your knowledge of each topic.

Lecture classes

№	The topic lecture name and list of main questions
Lecture 1	**Topic 1: Objectives and subject of the discipline "Mechanics of materials and structures". Basic models of material, body shape, loads, supports.** Course objectives and its place among general engineering disciplines. Material and its model. Basic models of body shape. Load modeling. Structural supports and their models. **Topic 2. Strength reliability model: basic stages and principles of construction.** Real structure and its design scheme. Basic hypotheses and principles of mechanics of materials and structures. Internal forces and the method of sections for their determination.
Lecture 2	**Topic 2. Strength reliability model: basic stages and principles of construction (continued).** The simplest types of rod loading. Construction of internal force diagrams for of internal forces for rods. Stresses. Integral equations of equilibrium for rods. Displacements and deformations. Estimation of strength reliability of a deformed body. Safety margin
Lecture 3	**Topic 5. Determination of stresses and strains in tension and compression.** Potential energy of deformation of the rod in tension-compression. Solution of the integral equation of equilibrium for pure tensile-compressive rod. Hypothesis of plane sections for a rod in tension-compression. Determination of the potential strain energy in tension-compression. **Topic 6. Determination of the main mechanical characteristics of materials in tension and compression. Determination of permissible stresses.** Tensile diagram in absolute and relative coordinates.
Lecture 4	**Topic 6: Determination of the main mechanical characteristics of materials in tension and compression. Determination of permissible stresses.** Determination of the mechanical characteristics of the material by the tensile diagram. Compression test. Determination of surface hardness. Influence of various factors on the mechanical properties of materials. Determination of permissible stresses.
Lecture 5	**Topic 7. Conditions of strength and stiffness of rods in tension and compression.** Conditions of strength and stiffness. The main types of calculations of rods using the conditions of strength and stiffness. **Topic 8. Calculations of strength and stiffness of statically determinate rods.** The concept of static determinacy of the system. Determination of stresses and strains in rods of statically determinate systems. Methods of performing verification and design calculations.

Lecture 6	**Topic 9. Calculations for strength and stiffness of statically indeterminate rods.** The concept of static indeterminacy of the system and examples of possible schemes. The degree of static uncertainty. Determination of stresses and strains in rods of statically indeterminate systems. Determination of stresses and strains in rods of statically indeterminate systems. Dependence of force values on the ratios of stiffnesses of system elements Influence of inaccuracy of manufacturing of elements of a statically indeterminate system on the magnitude of forces that arise in them after assembly and loading.
Lecture 7	**Topic 9. Calculations for strength and stiffness of statically indeterminate rods (continued).** Temperature stresses in elements of statically indeterminate systems. **Topic 10. Stressed state of a body at a point.** Stressed state at a point. The law of parity of tangential stresses.
Lecture 8	**Topic 10. Stressed state of the body at a point (continued).** Determination of stresses in the areas of common position. Stress tensor. Principal axes and principal stresses. Types of stress state. Determination of the magnitude and direction of principal stresses. Determination of stresses on non-major sites. Octahedral sites and octahedral stresses.
Lecture 9	**Topic 10. Stressed state of the body at a point.** The largest tangential stresses. Plane stress state: direct problem of plane stress state; inverse problem of plane stress state.
Lecture 10	**Topic 10. Stressed state of the body at a point (continued).** Linear stress state. **Topic 11. Deformed state of a body at a point.** The relationship between displacements and deformations (Cauchy's equation). Principal axes and principal deformations.
Lecture 11	**Topic 11. Deformed state of a body at a point (continued).** Deformation tensor. Volumetric deformation. **Topic 12: Generalized Hooke's law.** Generalized Hooke's law for major and minor axes of stress and strain.
Lecture 12	**Topic 12: Generalized Hooke's law (continued).** Hooke's law for volumetric deformation. **Topic 13. Potential strain energy in the general case of a stressed state.** Total and specific potential energy of deformation of a body at a point. Energy of volume change. Energy of change of shape.
Lecture 13	**Topic 14: The concept of strength criterion.** Criterion evaluation of strength reliability. Boundary surfaces of the material and their physical content. **Topic 15. Theories of strength.** Classical theories of strength. **Topic 16. Determination of shear stresses (shear) of the rod.** Shearing and crushing of rods. Conditions of shear and crushing strength. **Topic 17. Practical calculations for shear and crushing.** Calculations for shear strength. Calculations for strength at shear.

Lecture 14	**Topic 17. Practical calculations for shear and crushing (continued).** Calculations for the strength of welded joints. **Topic 18: Pure shear.** Pure shear as a special case of plane stress state. Strength testing and permissible stresses under pure shear conditions. Determination of the potential strain energy in pure shear.
Lecture 15	**Topic 19: Torsion of a round rod.** Determination of stresses and strains. Condition of strength and stiffness. The nature of rod fracture in torsion. **Topic 20. Torsion of rods of non-circular cross-section and thin-walled profile.** Features of the distribution of tangential stresses in non-circular sections of a rod in torsion. Torsion of a rod of rectangular cross section. Torsion of complex open profiles. Torsion of thin-walled profiles: open profiles; closed profiles.
Lecture 16	**Topic 21: Potential energy of deformation of a rod in torsion.** Determination of the potential strain energy in torsion. **Topic 22. Calculation of helical cylindrical springs with small pitch.** Determination of stresses in the cross section of the spring coil. Deformation of the spring. **Topic 23. Stresses in a straight bar in pure bending.** Solution of the integral equation of equilibrium for pure bending of the rod. The hypothesis of plane sections for a rod in pure bending.
Lecture 17	**Topic 24. Tangential stresses in a bar in plane transverse bending.** Assumptions about the nature of the distribution of tangential stresses in the section. Zhuravsky's formula. **Topic 25. Calculations for strength in plane transverse bending.** Analysis of the stress state of the rod along the height of the section in plane transverse bending. Conditions of strength. Basic condition of strength. Complete check of rods for strength in transverse bending. Selection of the rational shape of the bar cross-section in bending.
Lecture 18	**Topic 26. Bending of thin-walled profiles.** Tangential stresses in thin-walled profiles. The concept of the center of bending. **Topic 27. Calculations for stiffness in bending.** Displacements in rods in bending. Differential equation of the elastic line of the rod. Determination of displacements by integrating the differential equation of the elastic line of the rod. Conditions of rigidity of rods in bending. **Topic 28. Potential energy of deformation of the rod in bending.** Determination of the potential strain energy in bending.

Laboratory classes

The main task of the laboratory cycle is to practically test and consolidate the knowledge gained in lectures and practical classes.

№	Name of the laboratory work (computer workshop)	Number of classroom hours
1	Determination of mechanical properties in tension. Tensile diagram (Topic 6)	2
2	Testing materials for compression (Topic 6)	2
3	Determination of the modulus of elasticity in tension (Topic 6)	2
4	Testing materials for shear (Topic 16)	2
5	Determining the modulus of elasticity under shear (Topic 19)	2
6	Determining the elasticity characteristics of a spring (topic 22)	2
7	Investigation of the stress state of a beam in pure bending (Topic 23)	2
8	Determine the bending center position for thin-walled profiles (Topic 26)	2
9	Credit class	2

5. Independent work of the student

The student's independent work involves preparing for classroom classes, making calculations based on primary data obtained in laboratory classes, and drawing up laboratory protocols, solving problems, and preparing for module tests.

Policy and control

6. Policy of the discipline (educational component)

Rules for attending classes

When conducting classes remotely, in particular in the ZOOM network, the student must confirm his or her presence by turning on the microphone and camera at the request of the teacher.

Materials of missed classes must be worked out independently. Laboratory work is carried out according to the schedule of the department.

Rules of behavior in the classroom

Attendance at lectures and practical classes, as well as absences, are not graded. However, students are encouraged to attend classes, as they teach theoretical material and develop the skills necessary to complete the semester individual assignment. Students are expected to attend classes on time, without being late.

In lecture classes, students must have lecture notes or forms previously received from the teacher. Students have the right to ask questions to clarify unclear provisions, having previously requested permission.

For practical classes, students come prepared with the theory on the topics to be covered and have the necessary tools to complete the assignments (calculators, smartphones for accessing the Internet, etc.). All students must be active in discussing the issues raised for consideration, submit homework for review at the request of the teacher

Students come to laboratory classes prepared for laboratory work and familiarized with the safety rules for their performance. They must have protocol forms with them. During the work, all students must take an active part in its implementation, make the necessary records and calculations, which, after completion, are approved by the teacher.

Discipline during classes is mandatory. It involves not allowing extraneous conversations, using any gadgets or other devices for purposes other than those required by the tasks assigned by the teacher, and strictly preventing safety violations during laboratory work.

Rules for the protection of laboratory work

Only students who have completed their laboratory work in class and have properly completed and approved protocols by the instructor are allowed to defend it. The defense takes place in the form of a colloquium, based on the results of which the instructor conducts a point assessment and makes a conclusion about the credit or non-credit of the laboratory work.

Rules for protecting individual assignments

Individual assignments in the form of problems are submitted to the teacher for review after they are completed. After confirming the correctness of the solution, an interview is held on theoretical issues related to the assignment and the methodology for solving the problem. Based on the results of the interview, the teacher conducts a point assessment and makes a conclusion on whether or not the completed task is credited.

Rules for awarding reward and penalty points

These rules are reflected in the rating system (see paragraph 8).

Policy of deadlines and retakes

At the beginning of the semester, the instructor informs students about the control measures and their deadlines. Schedules for individual assignments and other types of work are announced, and deadlines for their completion and submission are set. The conditions and deadlines for retakes in case of a negative result of the previous attempt are also specified.

Violation of the deadlines is punishable by a reduction in points in the rating (see paragraph 8). The number of retakes is limited, but not less than three, and is set by the teacher..

Policy on academic integrity

In the course of studying the discipline, students complete individual assignments, defend laboratory work, write tests and take exams. At the same time, students and teachers are mutually guided by the principles of academic integrity regarding the inadmissibility of plagiarism, falsification of work results, corruption, etc.

Detection of signs of plagiarism in individual assignments results in the replacement of the assignment, lowering of the grade up to and including expulsion from the university.

7. Types of control and rating system for assessing learning outcomes (RSO)

During the semester, the following types of control of students' progress in the discipline are performed:

- Current control. Includes a quick survey on the topic of the class.
- Calendar control. It is held twice a semester as a monitoring of the current state of fulfillment of the requirements of the silhouette.
- Semester control.

The student's rating in the discipline consists of the points he/she receives for:

1) work in practical classes;
2) writing module tests;
3) performance and defense of individual works
4) performance and defense of laboratory work
5) written examination test.

8.1. System of rating (weight) points and evaluation criteria

8.1.1. Work in the classroom

The weighting score is 0.61. The maximum number of points in all practical classes during the semester is 0.61 points x 18 = 11 points.

Criteria for awarding points:

- - active creative work - 0.61 points;
- - fruitful work - 0.3 points;
- - passive work -0 points.

8.1.2. Modular control work

Weight score – 10.

Criteria for grading tests (maximum score):

- - the work is done correctly - 10 points;
- - the solution is correct, there are errors in the calculations - 7 - 9 points;
- - errors in the methodology of solving the problem - 1 - 6 points;
- - no solution to the problem - 0 points

8.1.3. Individual tasks

The weighting score is 3. The maximum number of points for all laboratory works is 3 points x 9 = 27 points.

Criteria for evaluating laboratory work:

- - flawless work - 3 points;
- - there are some shortcomings in the preparation and/or execution of the work - 1.5 points;
- - Work is not completed or not defended -0 points.

8.1.4. Laboratory work

The weighting score is 1.5. The maximum number of points for all laboratory works is 1.5 points x 8 = 12 points.

Criteria for evaluating laboratory work:

- flawless work - 1.5 points;
- there are some shortcomings in the preparation and/or execution of the work - 1 point;
- Work is not completed or not defended -0 points.

8.1.5. Reward points are awarded for:

- participation in the All-Ukrainian Olympiad in the discipline - +5 points;
- a prize place at the All-Ukrainian Olympiad in the discipline - +10 points;
- participation in the creation and modernization of the laboratory base and visualization of the department, other work to help the department (subject to the implementation of the curriculum) from +1 to +10 points.

8.1.6. Penalty points are accrued for:

- late submission of laboratory work -0.5 points;
- late submission of an individual assignment -1 point.

8.2. Calculation of the rating scale (R)

The sum of the weighting points of the control measures is

$$R_C = 11+10+27+12 = 60 \; points.$$

The scoring component of the scale is equal to (40 % від R):

$$R_C = 40 \; points.$$

8.3. Attestations

The condition for a positive first attestation is to obtain at least 8 points and complete all laboratory works (at the time of attestation). The condition for a positive second attestation is to receive at least 22 points, complete all laboratory works (at the time of attestation), provided that the calculation work is credited.

8.4. Admission to the examination

A prerequisite for admission to the exam is passing all laboratory works, calculations, and a starting rating of at least 26 points.

8.5. Criteria for evaluating answers at the test:

During the test, students complete a written test. Each assignment contains two theoretical questions and one practical task. The list of questions is given in paragraph 9 of this syllabus. Each question (assignment) is worth 12 points according to the following criteria:

- "excellent", complete answer, at least 90% of the necessary information, which is performed in accordance with the requirements for the "skills" level, (complete, error-free solution of the task) - 12-11 points
- "good", a sufficiently complete answer, at least 75% of the necessary information that is fulfilled in accordance with the requirements for the level of "skills or there are minor inaccuracies (complete solution of the task with minor inaccuracies) - 9-8 points
- "satisfactory", an incomplete answer, at least 60% of the necessary information, which is performed in accordance with the requirements for the "stereotypical" level and some errors (the task is performed with certain shortcomings) - 7-6 points;
- "unsatisfactory", the answer does not meet the requirements for "satisfactory" - 0 points.

The sum of the starting points and points for the exam test is converted to the exam grade according to the table:

Scores	Assessment
100…95	Excellent
94…85	Very good
84…75	Good
74…65	Satisfactory
64…60	Enough
Less 60	Unsatisfactory
There are unaccredited laboratory works or unaccredited calculation work	Not allowed

8. Additional information on the discipline (educational component)

QUESTIONS FROM THE DISCIPLINE

Basic hypotheses and principles of mechanics of materials and structures and examples of their application.

1. Models of materials and their applications.
2. Modeling of external forces in the problems of mechanics of materials and structures.
3. The concept of a design scheme. Modeling of body shape and supports.
4. Internal forces.
5. Methods for determining internal forces in a deformed body.
6. The simplest types of rod loading.
7. Differential relationships between internal forces in bending.
8. The concept of stress and strain.
9. System of integral equations of equilibrium of the rod.
10. Determination of the centers of gravity of symmetrical and asymmetrical sections.
11. Moments of inertia of plane sections. Methods of their determination.
12. Determination of moments of inertia for parallel axes.
13. Determination of moments of inertia when rotating axes.
14. Main axes and main moments of inertia.
15. Axial and polar moments of resistance. The procedure for their determination for arbitrary sections.
16. Determination of stresses and strains in a rod under pure tension-compression.
17. Conditions of strength and stiffness. The main types of calculations with their application.
18. Tensile diagram. Basic mechanical characteristics of materials in tension.
19. Compression test. Properties of different materials in compression.
20. Influence of various factors on the mechanical properties of materials.

21. Permissible stresses. Their definition depending on the type of material.
22. Statically determinate and statically indeterminate systems. Methods of their solution.
23. Features of statically indeterminate systems. Installation stresses.
24. Features of statically indeterminate systems. Temperature stresses.
25. Stressed state of the body at a point. The law of parity of tangential stresses.
26. Stress on the site of general position. Stress tensor.
27. Principal sites and principal stresses.
28. Determination of principal stresses (inverse problem of bulk stress state). Stress state invariants. Types of stress state.
29. Octahedral platforms. Normal and tangential stresses on an octahedral platform.
30. Direct and inverse problems of plane stress state.
31. Deformation of a body at a point. Cauchy's equation.
32. Volumetric deformation of a body at a point.
33. Generalized Hooke's law for an isotropic body.
34. Hooke's law for volumetric deformation.
35. Elastic constants of an isotropic material, their relationship and methods of determination.
36. Potential energy of deformation of a body at a point.
37. Strength criteria for brittle materials and materials that resist tension-compression differently.
38. Strength criteria for plastic materials.
39. Pure shear. Principal and permissible stresses. Hooke's law in pure shear.
40. Shearing and crushing of rods. Conditions of shear and crushing strength.
41. Calculation of the strength of welds.
42. Determination of stresses and strains in pure torsion of a circular rod. Calculations for strength and stiffness of round rods in torsion.
43. Features of the distribution of tangential stresses in rods of non-circular cross-section in torsion. Calculations for strength and stiffness in torsion of rods of rectangular cross section.
44. Torsion of thin-walled open profiles.
45. Torsion of thin-walled closed profiles.
46. Calculations for strength and stiffness of cylindrical springs with small pitch.
47. Determination of normal stresses in rods in pure bending.
48. Tangential stresses in a rod in transverse bending.
49. Analysis of the stress state of the rod along the height of the section in transverse bending. Basic condition of bending strength.
50. Displacement in bending. Differential equation of the elastic line of the rod.

Work program of the discipline (syllabus):

Compiled by senior lecturer of Department of Dynamics and Strength of Machines and Strength of Materials, PhD, Musiienko O.S.

and senior lecturer of Department of Dynamics and Strength of Machines and Strength of Materials, PhD, Koval V.V.

Approved by the Department of Dynamics and Strength of Machines and Strength of Materials (Minutes № 14 of 12.12.2023)

Approved by the Methodological Commission of the ER IME (Minutes № 4 of 22.12.2023)