Ministry of Education and Science of Ukraine
National Aerospace University
"Kharkiv Aviation Institute"

Department No. 102 Aircraft Strength

Approved by
Methodologic commission
of higher education branches of knowledge
"Mechanical Engineering",
"Electrical Engineering", "Transport"
"Military Sciences, National
Security and State Border Security",

Romanov M.
(signature)(initials and surname)

"___" _____ 2021

COURSE SYLLABUS

Mechanics of Materials
(title of course)

Branch of knowledge: 13 Mechanical Engineering, 27 Transport Services
(code and title of branch of knowledge)

Directions of studying (specialties):
134 Aerospace Engineering, 272 Aviation Transport
(code and title of direction of studying)

Educational programs:
ID 99 Aircraft Designing
ID 1291 Engineering Maintenance of and Engines
ID 23452 Technologies of Aircraft Manufacturing and Repair
ID 23463 Design, Operational Diagnostics, Maintenance and Repair of Aircraft Engines and Power Plants
ID 1163 Rocket and Space Complexes
ID 17903 Design and Manufacturing of Composite Structures
ID 39606 Design, Manufacture and Certification of Aircraft
ID 51031 Design and Maintenance of Aircraft
ID 961 Aircraft Engines and Power Plants
ID 98 Aircraft Engine and Power Plant Production Technologies
ID 1053 Rocket Engines and Power Plants
ID 17908 Unmanned Flight Vehicles
ID 17909 Satellites, Engines and Power Plants

Kharkiv 2021

Course syllabus Mechanics of materials for students
(title of course)
of directions of studying (specialties):
134 Aerospace Engineering, 272 Aviation Transport
(code and title of direction of studying)
on 30.08.2021, 15 pages.
Developed by cand. of science,
prof. of 102 Dept. _____ Vladislav Demenko
(signature) (name and surname)

Course syllabus is approved by Department of Aircraft Strength meeting
(name of department)
Record of proceeding №2 from 30.08.2021.
Head of department,
doctor of science, professor _____ Vitalii Miroshnikov
(signature) (name and surname)
"____" _____2021.

Approved by methodological commission of National Aerospace University "Kharkiv Aviation Institute", branches of knowledge
13 "Mechanical Engineering", 14 "Electrical Engineering", 27 "Transport Services", 25 "Military Sciences, National Security and State Border Security"
(title of branch of knowledge)
Record of Proceeding No. __ from _____ 2021.
secretary _____ Nataliya Rudenko
(signature) (name and surname)

1. Description of the course

<table>
<tr><td rowspan="3">Indicators</td><td>Branch of knowledge, direction of studying, educational and qualification level</td><td colspan="2">Characteristics of the course
full-time education</td></tr>
<tr><td>Branch of knowledge
13 Mechanical engineering
27 Transport services
(code and title)</td><td colspan="2" rowspan="2">Normative</td></tr>
<tr><td>Directions of studying
134 – Aerospace Engineering
272 – Aviation transport
(code and title)</td></tr>
<tr><td>Content modules – 12</td><td rowspan="4">Specialty (professional direction):</td><td colspan="2">Years of studying:</td></tr>
<tr><td>Topics – 16</td><td colspan="2">2021/2022</td></tr>
<tr><td>Individual scientific-research tasks №№1-18
(title)</td><td colspan="2">Semester</td></tr>
<tr><td>Total hours – 300</td><td>3</td><td>4</td></tr>
<tr><td rowspan="11">Weekly rate for full-time education (hours):
auditoria – 5
self-studying (including individual home problems solutions) – 5.
Total number of credits ECTS – 10</td><td rowspan="11">Educational-qualification level:

Bachelor</td><td colspan="2">Lectures</td></tr>
<tr><td>32 hrs</td><td>32 hrs</td></tr>
<tr><td colspan="2">Practical, seminar classes</td></tr>
<tr><td>32 hrs</td><td>32 hrs</td></tr>
<tr><td colspan="2">Laboratory classes</td></tr>
<tr><td>8 hrs</td><td>8 hrs</td></tr>
<tr><td colspan="2">Self-learning, including individual home problems</td></tr>
<tr><td>60 hrs</td><td>96 hrs</td></tr>
<tr><td colspan="2">Individual home problems:</td></tr>
<tr><td>34 hrs</td><td>64 hrs</td></tr>
<tr><td colspan="2">Control type:</td></tr>
<tr><td>moduli control, exam</td><td>moduli control, exam</td></tr>
</table>

Notes.

Ratio between auditoria classes to self-studying and individual studying (hours):
for full-time education – 144/152.

2. Introduction

2.1 Learning Objectives

The course aims are to equip students with general principles and methods of strength, rigidity and stability analysis of basic engineering structures. Students are encouraged to design high-performance structures under mechanical and thermo-mechanical loadings. Structural elements studied include rods and rod systems in tension-compression; shafts in torsion; beams in bending; rod structures under combined loading. The laws and hypotheses in mechanics of deformable solids are proposed as basis for engineering analysis of stresses and strains. Various types of stress and strain state in engineering structures are covered due to wide presence of rod-shaped structural elements in civil and mechanical (aerospace) engineering.

2.2 Integral Competencies

Ability for complex and practical problem solutions in field of design, manufacturing, maintenance, repair and certification of aerospace flight vehicles grounding on application of advanced theories and methods of higher mathematics, physics, material science at high level of data indeterminacy.

2.3 General Competencies

GC 1. Ability for Ukrainian language oral and writing communications.
GC 2. Ability for English language communication.
GC 3. Skill of safe human activity and environmental protection.
GC 4. Skill in IT application to flight vehicles design, manufacturing, maintenance, repair and certification.
GC 5. Ability to support team spirit, creativity, analyticity.
GC 6. Skill in search of information, its analysis and application.
GC 7. Ability to maintain high level of professional activity quality.
GC 8. Ability to provide high ethic guidelines in engineering.

2.4 Special Competencies and Learning Outcomes

SC 1. Skill in application of fundamental laws of physics in mechanics, electromagnetism, heat transfer with application to machine design.
SC 2. Skill in application of general laws of deformable solid analysis.
SC 3. Skill in implementation of engineering hypotheses in solution of the problems of strength, rigidity and stability.
SC 4. Skill in stress-strain state analysis of deformable solid, its limiting stress state and classic strength theories.
SC 5. Skill in application of classical and contemporary methods for experimental study of stress-strain state of deformable solid.
SC 6. High skill in practical use of engineering methods and algorithms for analytical study of rod shaped structural elements for strength, rigidity and stability.
SC 7. Ability in adequate design model selecting and application to structural element analysis.
SC 8. Ability of typical structural elements analysis for strength, rigidity and stability applying engineering analytical methods which provide required accuracy of results.
SC 9. Skill in providing of experimental investigations of stress-strain state of structural elements.

SC 10. High skill in experimental investigation of basic mechanical properties of structural materials in result of their mechanical tests.

2.5 Interdisciplinary Relations (prerequisites/postrequisites)

The course "Mechanics of Materials" is based on the prerequisite disciplines that have been studied earlier. The prerequisites are: "Essentials of Higher Mathematics", "General Physics", "Materials Science and Engineering", "Classical Mechanics", "General Chemistry". The "Mechanics of Materials" is considering as the foundation of education in "Aerospace Engineering". Within the frameworks of given course the attention is focusing on the aspects which could be used in solving the problems of design a flying vehicles, power plants and weaponry.

3. Syllabus content

Content module 1

Topic 1 – Geometrical Properties of Plane Areas.

Introduction. Area of cross-section. Static moment (first moment) of area in orthogonal system of coordinates. Concepts of plane area centroid, central axes, centroid of composite areas. Axial moments (second moments) and product of inertia for the plane area. Parallel-axis theorems for moments and products of inertia. Polar moment of inertia. Moments of inertia in rotation of axes. Principal axes of inertia. Calculation of principal moments of inertia and orientation of principal axes. Invariability of axial moments of inertia sum in rotation of axes. Sectional modulus of cross-section. Radii of cross-section gyration.

Content module 2

Topic 2 – Introduction to Mechanics of Materials. General Concepts and Assumptions.

Mechanics of materials – the science of strength, rigidity and stability of structural elements as deformable solids. Prismatic bar as a general object in Mechanics of materials. Relations between problems of mechanics of materials, theoretical mechanics and material science. Concept of displacement in a point of deformable solid under external loading. Deformations at a point of deformable solid. Elastic and plastic deformations, ideal elasticity and plasticity. Concepts of homogeneous and non-homogeneous deformation. Concept of stress. Principal hypotheses in mechanics of materials: continuity, homogeneity, isotropy. Concept of solid properties anisotropy. Principle of superposition. Hypotheses of initial non-stressed state. Structure and its idealized design model. Problem of adequate design model. The concept of prismatic bar as a typical structural element in Mechanics of materials. Hypothesis of plane sections as the basis for designing the conditions of compatibility in analysis of stress distribution in the bar cross sections. General engineering problems in Mechanics of materials: analysis of strength, rigidity and stability for prismatic bar, design problem, problem of allowable external loading.

Content module 3

Topic 3 – Internal Forces in Prismatic Bar.

Classification of external forces. Resultant of distributed load. Reactions of supports. Saint-Venant's principle. Principle of superposition. The work of the external force applied to deformable solid. Concepts of generalized force and generalized displacement. Internal forces as a result of external forces application. Physical and analytical grounding of internal forces existence. Method of sections for calculation of internal forces in an arbitrary cross section of deformable solid. Concept of resultant vector and resultant vector moment of internal forces in cross section. Concept of stress at a point of deformable solid. Types of stresses. Relationship between resultant internal forces and stresses. Static indeterminacy of stress distribution in cross section. Concepts of stress and strain state at a point of deformable solid. Internal forces in cross-sections of prismatic bar and their graphs (diagrams) of distribution along the length of a bar. Normal force distribution in tension-compression. Sign convention. The examples of internal forces diagrams designing. Torque moment distribution in torsional deformation. Sign convention. The examples of internal forces diagrams designing. Shear force and bending moment distributions in plane bending. Sign conventions. Differential relationships between the bending moment, the shear force and the intensity of distributed load. The diagrams of internal forces distribution in statically determined frames and bar systems under combined loading. General rules for the diagrams of internal forces distribution checking.

Content module 4

Topic 4 – Analysis of Stresses and Strains at a Point of Deformable Solid.

State of stress at a point of deformable solid. Homogeneous and non-homogeneous stress states. Signs of normal and shear stresses. Stress tensor. Law of equality for shear stresses. Uniaxial stress state. Hooke's law. Lateral strain. Poisson's ratio. Plane stress state (plane stress). Stresses on inclined sections, transformation equations for plane stresses. Special cases of plane stress state (uniaxial stress, pure shear, biaxial stress). Hooke's law in shear. Graphical method of plane stress state analysis and circular diagrams of stress state (Mohr's circles: equations of Mohr's circle, construction of Mohr's circle, stresses on inclined sections). Principal planes. Principal stresses. Extremity of principal stresses. Maximal shear stresses. Examples of analytical and graphical solutions of plane stress state problems: (a) direct problem of plane stress state (calculation of stresses on inclined planes); (b) inverse problem of plane stress state (determination of principal planes position and calculation of principal stresses). Hooke's law for plane stress state. Unit volume change. Strain energy density. Applications of plane stress state. Pressure vessels. Triaxial stress state. Maximal shear stress. Hooke's law for triaxial stress state. Unit volume change (dilatation). Strain energy and strain energy density. Spherical stresses. Plane strain state. Plane strain vs. plane stress. Transformation equations for plane strain. Maximal shear strains. Mohr's circle for plane strain. Strain measurements and calculation of stresses.

Content module 5

Topic 5 – Material Testing in Tension-Compression. Mechanical Properties of Structural Materials. Assumptions and hypotheses in Mechanics of Materials.

Mechanical testing of materials as general method to determine mechanical properties of structural material and to check the theoretical analysis accuracy. Types of mechanical testing, equipment and specimens. Tension test as the main method of experimental study of material properties. Tension test diagram. Basic mechanical characteristics of materials. Material testing in compression. Limiting stress. Allowable stress. Influence of temperature and time on material mechanical properties. Creep and stress relaxation. Long-term strength. Influence of strain rate on a material resistance to mechanical loading.

Content module 6

Topic 6 – Strength and Rigidity of Bars and Bar Systems in Tension–Compression.

Stresses in cross-section of the bar. Condition of strength. Change in length of axially loaded members. Elongation and stiffness of a prismatic bar. Condition of rigidity. Change in length of nonuniform bars. Statically indeterminate bars and bar systems in tension-compression. Thermal effects and temperature-displacement relation. Strain energy in linearly elastic behavior. Strain-energy density.

Topic 7 – Strength and Rigidity of Bar in Torsion.

Torsional deformation of a circular bar. The torsion formula and condition of strength in torsion. Angle of twist and condition of rigidity. Torsional stiffness, torsional rigidity, torsional flexibility. Nonuniform torsion. Statically indeterminate members in torsion. Equations of compatibility. Strain energy in torsion and pure shear. Strain energy density in pure shear. Thin-walled tubes. Shear stress. Shear flow.

Topic 8 – Strength and Rigidity of Bar in Plane Bending.

Stresses and deflections in pure and nonuniform (transverse) bending. Curvature of a beam. Longitudinal strains in beams. Normal stresses in beams. Location of neutral axes, moment-curvature relationship, flexure formula, maximum stresses in a cross-section. Condition of strength in pure bending. Design of beams for bending. Shear stresses in beams. Derivation of shear formula. Distribution of shear stresses in a rectangular beam. Effect of shear strains (warping of cross-section). Shear stresses in beams of circular cross-section. Shear stresses in the webs of beams with flanges. Maximal and minimal shear stresses. Comparison of normal and shear stresses in bending. Deflection of beams. Differential equations of a deflection curve.

Content module 7

Topic 9 – Combined Stresses. Classic Strength Theories.

Application of strength theories. Limiting state of stress. Equally dangerous states of stress. Equivalent stress. Classic theories of strength: Maximum normal stress theory, Maximum linear strain theory, Maximum shearing stress theory, Distortion energy theory.

Topic 10 – Stress Analysis in Combined Loading.

Bending, torsion and tension of a rectangular bar. Bending and torsion of a circular cross section. Bending, torsion and tension of a circular cross-section. Unsymmetrical (oblique) bending. Eccentric tension and compression.

Content module 8

Topic 11 – Generalized Displacements. Mohr's Method for Calculation of Generalized Displacements.

Displacements of a rod under arbitrary loading. The work done by external forces. The work done by internal forces. Strain energy of elastic deformation. The reciprocal theorems. Mohr's integral. Determination of displacements. Vereshchagin's graphical method for Mohr's integral calculation.

Topic 12 – Analysis of Statically Indeterminate Bars and Bar Systems by the Force Method and Three Moments Equation.

Essence of the force method. Singly statically indeterminate frame. Two-fold statically indeterminate frame. Multispan beams: examples of application.

Content module 9

Topic 13 – Buckling of Columns.

Concept of buckling of a rod. The Euler's problem. Effect of boundary conditions on the critical load. Critical stresses. Conditions of the Euler's formula applicability. Yasinsky's formula. Condition of stability. Buckling prevention in civil engineering. Design formula for columns.

Content module 10

Topic 14 – Repeated Loading and Fatigue Strength.

Characteristics of a cyclic loading. Wöhler's curve and fatigue limit. Effect of stress concentration, surface finish and size of a part on fatigue strength. Factor of safety in fatigue and its analytical and graphical determination.

Content module 11

Topic 15 – Stresses in Symmetrical Shells.

Basic features of shells. Calculation of stresses in symmetrical shell. Laplace's equation. Complementary equation for calculation of acting stresses. Strength condition.

Content module 12

Topic 16 – Dynamic Loading.

Dynamic factor and its calculation. Strength condition for the impact loading. Longitudinal impact. Transverse impact.

4. Course content arrangement

Content modules and topics	Hours					
	full-time education					
	total	including				
		lec	pract	lab	indiv HP	self-educ
1	2	3	4	5	6	7
Content module 1						
Topic 1 – Geometrical Properties of Plane Areas. Home Problem 1	14	2	2	-	6	4
Moduli control (home problem 1)	1					1
Total in content module 1	15	2	2	-	6	5
Content module 2						
Topic 2 – Introduction to Mechanics of Materials. General Concepts and Assumptions	2	2	-	-	-	-
Moduli control (home problem)						-
Total in content module 2	2	2	-	-	-	-
Content module 3						
Topic 3 – Internal Forces in Prismatic Bar and Plane Frame. Home Problems 2, 3, 4, 5, 6	41	8	6	-	22	5
Moduli control (home problems 2, 3, 4, 5, 6)	5					5
Total in content module 3	46	8	6	-	22	10
Content module 4						
Topic 4 – Analysis of Stresses and Strains at a Point of Deformable Solid	14	6	4	-	-	4
Moduli control (home problem)						-
Total in content module 4	14	6	4	-	-	4
Content module 5						
Topic 5 – Material Testing in Tension-Compression. Mechanical Properties of Structural Materials. Assumptions and hypotheses in Mechanics of Materials	7	2	2	2	-	1
Moduli control (home problem)						-
Total in content module 5	7	2	2	2	-	1
Content module 6						
Topic 6 – Strength and Rigidity of Bars and Bar Systems in Tension-Compression. Home Problem 7	16	4	6	-	4	2
Topic 7 – Strength and Rigidity of Bar in Torsion. Home Problem 8	17	3	6	2	4	2
Topic 8 – Strength and Rigidity of Bar in Plane Bending. Home Problem 9	26	5	8	2	8	3
Moduli control (home problems 7, 8, 9)	3					3

Total in content module 6	62	12	20	4	16	10
Content module 7						
Topic 9 – Combined Stresses. Classic Strength Theories.	4	2	-	-	-	2
Topic 10 – Stress Analysis in Combined Loading. Home Problems 10, 11 or 12	39	4	8	2	21	4
Moduli control (home problems 10, 11 or 12)	2					2
Total in content module 7	45	6	8	1	21	6
Content module 8						
Topic 11 – Generalized Displacements. Mohr's Method for Calculation of General Displacements. Home Problems 13, 14, 15	32	6	6	2	14	4
Topic 12 – Analysis of Statically Indeterminate Bars and Bar Systems by the Force Method and Three Moments Equation. Home Problems 16, 17	44	10	8	2	20	4
Moduli control (home problems 13, 14, 15, 16, 17)	5					5
Total in content module 8	81	16	14	4	34	13
Content module 9						
Topic 13 – Buckling of Columns. Home Problem 18	15	4	4	2	3	2
Moduli control (home problem 18)	1					1
Total in content module 9	16	4	4	2	3	3
Content module 10						
Topic 14 – Repeated Loading and Fatigue Strength.	4	4	-	-	-	-
Moduli control (home problem)						-
Total in content module 10	4	4	-	-	-	-
Content module 11						
Topic 15 – Stresses in Symmetrical Shells.	5	1	4	-	-	-
Moduli control (home problem)						-
Total in content module 11	5	1	4	-	-	-
Content module 12						
Topic 16 – Impact Loading.	1	1	-	-	-	-
Moduli control (home problem)						-
Total in content module 12	1	1	-	-	-	-
Total hours	300	64	64	16	102	54

Note.

1. Theoretical study of strength analysis of bar in plane bending is included in first semester term. Its practical study is included in second semester term.

2. Home Problem 11 is alternative to Home Problem 12.

5. Practical class themes

Nb.	Topic name	Hours
1	Topic 1 – Geometrical Properties of Plane Areas	2
2	Topic 3 – Internal Forces in Prismatic Bar and Plane Frame	6
3	Topic 4 – Analysis of Stresses and Strains in Deformable Solid	4
4	Topic 5 – Material Testing in Tension-Compression. Mechanical Properties of Structural Materials. Assumptions and hypotheses in Mechanics of Materials	2
5	Topic 6 – Strength and Rigidity of Bars and Bar Systems in Tension–Compression	6
6	Topic 7 – Strength and Rigidity of Bar in Torsion	6
7	Topic 8 – Strength and Rigidity of Bar in Plane Bending	8
8	Topic 10 – Stress Analysis in Combined Loading	8
9	Topic 11 – Generalized Displacements. Mohr's Method for Calculation of Generalized Displacements.	6
10	Topic 12 – Analysis of Statically Indeterminate Bars and Bar Systems by the Force Method and Three Moments Equation.	8
11	Topic 13 – Buckling of Columns.	4
12	Topic 15 – Stresses in Symmetrical Shells	4
	Total	**64**

6. Laboratory class themes

Nb.	Topic name	Hours
1	Topic 2 – Introduction to Mechanics of Materials. Linearly Elastic Isotropic Solid: Assumptions and Hypotheses.	2
2	Topic 5 – Material Testing in Tension-Compression. Mechanical Properties of Structural Materials.	2
3	Topic 8 – Strength and Rigidity of Bar in Plane Bending. Experimental Study of Stress Distribution in Cross Section.	2
4	Topic 10 – Stress Analysis in Combined Loading	2
5	Topic 11 – Generalized Displacements. Mohr's Method for Calculation of Generalized Displacements.	2
6	Topic 12 – Analysis of Statically Indeterminate Bars and Bar Systems by the Force Method.	2
7	Topic 13 – Buckling of Columns.	2
8	Topic 16 – Dynamic Factor and Dynamic Stresses	2
	Total	**16**

7. Self-studying

Nb.	Topics	Hours
1	Topic 1 – Geometrical Properties of Plane Areas	5
2	Topic 3 – Internal Forces in Prismatic Bar and Plane Frame	10
3	Topic 4 – Analysis of Stresses and Strains in Deformable Solid	4
4	Topic 5 – Material Testing in Tension-Compression. Mechanical Properties of Structural Materials. Assumptions and hypotheses in Mechanics of Materials	1
5	Topic 6 – Strength and Rigidity of Bars and Bar Systems in Tension–Compression	3
6	Topic 7 – Strength and Rigidity of Bar in Torsion	3
7	Topic 8 – Strength and Rigidity of Bar in Plane Bending	4
8	Topic 9 – Combined Stresses. Classic Strength Theories	2
9	Topic 10 – Stress Analysis in Combined Loading	6
10	Topic 11 – Generalized Displacements. Mohr's Method for Calculation of General Displacements.	7
11	Topic 12 – Analysis of Statically Indeterminate Bars and Bar Systems by the Force Method and Three Moments Equation.	6
12	Topic 13 – Buckling of Columns.	3
	Total	**54**

8. Individual Home Problems

№ п/п	Name	Hours
1	Home Problem 1. Geometrical Properties of Plane Area. Principal Central Moments of Inertia for Composite Area (6 hours)	6
2	Home Problem 2. Normal Force Distribution in Tension-Compression (2 hours)	2
3	Home Problem 3. Torsional Moment Distribution in Torsion (2 hours)	2
4	Home Problem 4. Shear Force and Bending Moment Distribution in Plane Bending (Cantilevers) (3 hours)	2
5	Home Problem 5. Force and Bending Moment Distribution in Plane Bending (Two-Supported Beams) (6 hours)	6
6	Home Problem 6. Shear and Normal Forces and Bending Moment Distribution in Plane Bending of Statically Determinate Frames (7 hours)	8
7	Home Problem 7. Stresses and Elongations in Statically	4

	Indeterminate Rod in Tension-Compression (4 hours)	
8	Home Problem 8. Strength and Rigidity Analysis of Statically Determinate Shaft (4 hours)	4
9	Home Problem 9. Stress Analysis of Two Supported Beam in Plane Bending (8 hours)	8
10	Home Problem 10. Stress Analysis of Rod System in Combined Loading (14 hours)	14
11	Home Problem 11. Stress Analysis of Beam in Oblique Bending (5 hours)	5
12	Home Problem 12. Stress Analysis in Eccentric Tension-Compression (5 hours)	5
13	Home Problem 13. Generalized Displacements in Cantilever in Plane Bending (4 hours)	4
14	Home Problem 14. Generalized Displacements in Two supported Beam in Plane Bending (4 hours)	4
15	Home Problem 15. Generalized Displacements in Plane Frame in Plane Bending (6 hours)	6
16	Home Problem 16. Internal Forces in Statically Indeterminate Plane Frame (10 hours)	10
17	Home Problem 17. Internal Forces in Multispan Beam (10 hours)	10
18	Home Problem 18. Buckling and Stability of Compressed Rod (3 hours)	3
	Total	**103 (in fact 98)**

9. Methods of studying

Auditoria (online) lectures and practice, laboratory works (auditoria only), individual consultations, self-studying supported by teaching aids published by department 102 (http://k102.khai.edu/) and exposed in "Mentor" (course "Mechanics of Materials and Structures", link in Google Drive https://drive.google.com/drive/folders/1SxxTG9e_-EFjueHXuKiES3YGXjoXvF8Q?usp=sharing).

10. Knowledge and competencies evaluation system

A) Accumulative skill evaluation system based on semester results (24.12.2021 – autumn semester, 03.06.2022 – spring semester)

1) Solving, submitting and auditorium defending of home tasks (9 topics per semester related to modules 1-8 (autumn semester) and 9-18 (spring semester)). Total – 60…90 points per semester as average value.

2) Complementary 0…10 points for auditorium activity (lecture discussions, practical class answers, laboratory work activity).

B) Examination control during examination period (after 24.12.2021 – autumn semester, after 03.06.2022 – spring semester).

1) Prerequisite: 60+ points of module control in section A.
2) Auditorium solution of 2 practical problems from the listing in Mentor and Google Drive, and also two theoretical questions answers (in written form). Results distribution:
- theoretical questions – 0…10 points for each of two;
- practical problems – 0…40 points for each of two.
3) For the case of unsuccessful module control: - written examination.
Labs passing through multiple-choice testing, module control, final written exams (in unsuccessful moduli control).

11. Estimation scale (national scale)

<table>
<tr><td rowspan="2">Total score by all studying activities</td><td colspan="2">Mark by national scale</td></tr>
<tr><td>for exam, course project (paper), internship</td><td>for credit</td></tr>
<tr><td>90 – 100</td><td>excellent</td><td rowspan="5">passed</td></tr>
<tr><td>82 – 89</td><td rowspan="2">good</td></tr>
<tr><td>74 – 81</td></tr>
<tr><td>64 – 73</td><td rowspan="2">satisfactory</td></tr>
<tr><td>60 – 63</td></tr>
<tr><td>35 – 59</td><td>not passed (repassing is allowed)</td><td>not passed (repassing is allowed)</td></tr>
<tr><td>0 – 34</td><td>not passed (repassing is not allowed)</td><td>not passed (repassing is not allowed)</td></tr>
</table>

12. Basic literature sources

1. Beer, F. P. Mechanics of Materials / F. P. Beer, E. Russell Johnston Jr., J. T. DeWolf. – Mc. Graw Hill. – 705 p.
2. Beer, F. P. Statics and Mechanics of Materials / F. P. Beer, E. R. Johnston Jr., J. T. DeWolf, D. F. Mazurek. – Mc. Graw Hill, 2009. – 736 p.
3. Case, J. Strength of Materials and Structures / J. Case, Lord Chilver, C. T. F. Ross. – 4th ed. – John Wiley & Sons Inc., 1999. – 719 p.
4. Craig, R. R. Mechanics of materials / R. R. Craig, Jr. – John Wiley & Sons, 2011. – 859 p.
5. Gere, J. M. Mechanics of Materials / J. M. Gere. – 6th ed. – Thomson Learning, Inc., 2004. – 964 p.
6. Gere, J. M. Mechanics of Materials / J. M. Gere, S. P. Timoshenko. – PWS Publishing Company, 1996. – 832 p.
7. Hibbeler, R. C. Mechanics of materials / R. C. Hibbeler. – 8th ed. – Pearson, 2011. – 883 p.
8. Pytel, A. Mechanics of Materials / A. Pytel, J. Kiusalaas. – 2nd ed. – Cengage Learning, 2012. – 576 p.
9. Steif, P. S. Mechanics of Materials / P. S. Steif. – Pearson, 2012. – 591 p.
10. Karpov Ya., Demenko V., Lepikhin P., Popova O., Sikulskiy V., Taran A., Taranenko I., Yastremska T.. Physical principles of structural materials selection. –Textbook. –Kharkiv: National aerospace university "Kharkiv aviation in-

stitute", 2004 – 403 p.
11. Karpov Ya., Demenko V., Lepikhin P., Popova O., Shevtchuk R., Sikulskiy V., Taranenko I., Yastremska T.. Structural materials. –Handbook. –Kharkiv: National aerospace university "Kharkiv aviation institute", 2005 – 246 p.
12. Geometrical Properties of Plane Areas/ Demenko V.. – Kharkiv: National Aerospace University "Kharkiv Aviation Institute", 2006. – 90 p.
13. Examples and problems in mechanics of materials. Stress-strain state at a point of elastic deformable solid / Demenko V.. – Kharkiv: National Aerospace University "Kharkiv Aviation Institute", 2010. – 291 p

13. Recommended literature sources

1. Asaro, R. J. Mechanics of Solids and Materials / R. J. Asaro, V. A. Lubarda. – Cambridge University Press, 2006. – 860 p.
2. ASM Handbook. Vol. 1: Properties and Selection: Irons, Steels, and High-Performance Alloys. – ASM International, Materials Park, OH. 1990. – 1063 p.
3. ASM Handbook. Vol. 2: Properties and Selection: Nonferrous Alloys and Special-Purpose Materials. – ASM International, Materials Park, OH. 1990. – 1328 p.
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14. Information resources

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