# RTU Course "Technical Mechanics"

## 15E03 Lidaparātu teorijas un konstrukcijas katedra

*General data*

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|---|---|
| Code | TAS215 |
| Course title | Technical Mechanics |
| Course status in the programme | Compulsory/Courses of Limited Choice |
| Course level | Undergraduate Studies |
| Course type | Professional |
| Field of study | Mechanics, Mechanical Engineering, Machine Building |
| Responsible instructor | Pavelko Vitālijs |
| Volume of the course: parts and credits points | 2 parts, 4.0 Credit Points, 6.0 ECTS credits |
| Language of instruction | LV, EN, RU |
| Possibility of distance learning | Not planned |
| Abstract | 1st part: Fundamentals of mechanics. Statics. Basis of the statics. Load. Force. Moment of force. Pure moment Couple). Force reducing to center. Friction. Kinematics of a point. Solid kinematics. Euler's angles and angles' coordinates systems used in aviation. Fundamentals of inertial navigation theory. Spherical movement of a solid. Dynamics of a material point and its equations. Dynamics of a mechanic system. Dynamics of a solid. Fundamentals of Gyroscopes theory and its application in aviation.<br>2nd part: Internal forces and stresses. Tension (compression) of a rod. Strength condition. Tension (compression) deformation of a rod. Hooke’s law. Stress state and its shapes. Generalized Hooke’s law. Shear deformation. Torsion. Stress and strain of a round rod at torsion. Strength condition and a rod analysis at torsion. Small pitch cylindrical spring: stresses and elongations. Cross-section static and inertia moments. Bending of a beam. Bending moment and shear force. Direct and shear stress. Deflection of a beam. Buckling. Euler’s formula. Critical stress. Aircraft rivets. Bearings. Control cables. Springs. Transmissions. |
| Goals and objectives of the course in terms of competences and skills | To be able to analyze simple problems of the machines and mechanisms using knowledge of technical mechanics.<br>To learn the fundamentals of the inertial navigation theory and to use this knowledge for analysis of practical problems in aviation.<br>To learn the fundamentals of Gyroscopes theory and its application in aviation.<br>To be able to execute simple engineering analysis of strength and stiffness and to use this knowledge of technical mechanics in practice. |
| Structure and tasks of independent studies | Tests and preparation of reports on laboratory and home works: • Test 1: Statics problems (2 h); • Home work 1: Rod system analysis (2 h.) • Test 2: Material point and solid kinematics (2 h.); • Home work 2: Inertial navigation algorithm (2 h.); •<br>Test 3: Dynamics of a material point solid (2 h.); • Home work 3: Statics undefined rod systems analysis (2 h.); • Home work 4: Shaft at torsion (2 h.); • Home work 5: Beam bending (2 h.); • Laboratory work: Fundamental of electrical strain measurement (4 h); • Work with the literature (12 h). |
| Recommended literature | 1. Airframe and Powerplant Mechanics. Airframe Handbook. US Department of Transportation. Federal Aviation Administration. New Delhi: Himalayan Books. 2000, 630p.<br>2. Mechanical Engineer's Handbook// Part 1. Materials and Mechanical Design; Part 2.Systems and Controle/ Second Edition, Edited by MYER KUTZ, Myer Kutz Associates, Inc. - © 1998 by John Wiley & Sons, Inc.<br>3. MECHANISMS & MECHANICAL DEVICES SOURCEBOOK//Third Edition.-NEIL SCLATER, NICHOLAS P. CHIRONIS. - McGraw-Hill: New York o 2003. ISBN 0-07-136169-3<br>4. V.Pavelko. Sertifikācija un standarti aviācijas transportā// Lekciju konspekts. - Rīga, RTU, 2006.<br>5. Aerospace Materials. Hardcover ASTM Standards Related to Materials, Coatings and Testing for Fasteners. 1997. 434p.<br>6. Aircraft Structures and Materials. 1997. 434p.<br>7. Standard Aircraft Handbook. For Mechanics and Technicians. Sixth Edition. Edited by Larry Reithmaier. 1999. 292p.<br>8. Ē.Ozoliņš. Materiāli un izstrādājumi // Lekciju konspekts. - Rīga, RTU, 2004.<br>9. V.Pavelko. Materiālu pretestība // Lekciju konspekts (1. un 2.daļa). - Rīga, RAU, 1998. |
| Course prerequisites | Mathematics, physics, materialscience. |

*Course outline*

| Theme | Hours |
|---|---|
| Fundamentals of mechanics. Statics. | 2 |
| Basis of the statics. Load. Force. | 2 |
| Moment of force. Pure moment Couple). | 2 |
| Force reducing to centre. | 2 |
| Friction. | 2 |

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|---|---|
| Kinematics of a point. | 2 |
| Solid kinematics. | 2 |
| Euler's angles and angles' coordinates systems used in aviation. | 4 |
| Fundamentals of the inertial navigation theory. | 2 |
| Spherical movement of a solid. | 2 |
| Dynamics of a material point and its equations. | 2 |
| Dynamics of a mechanic system. | 2 |
| Dynamics of a solid. | 2 |
| Fundamentals of Gyroscopes theory and its application in aviation. | 4 |
| Internal forces and stresses. | 2 |
| Tension (compression) of a rod. Strength condition. | 2 |
| Tension (compression) deformation of a rod. Hooke’s law. | 2 |
| Stress state and its shapes. Generalized Hooke’s law. | 2 |
| Shear deformation. Torsion. | 2 |
| Stress and strain of a round rod at torsion. Strength condition and a rod analysis at torsion. | 2 |
| Small pitch cylindrical spring: stresses and elongations. | 2 |
| Cross-section static and inertia moments. | 2 |
| Bending of a beam. Bending moment and shear force. | 2 |
| Direct and shear stress at bending. | 2 |
| Deflection of a beam. | 2 |
| Buckling. Euler’s formula. Critical stress | 2 |
| Aircraft rivets. Bearings. | 4 |
| Control cables. Springs. Transmissions. | 4 |

*Learning outcomes and assessment*

| Learning outcomes | Assessment methods |
|---|---|
| To be able to analyze the statics problem. | 1st test: Statics problems |
| To be able to use analytical conditions of equilibrium. To be able to solve a rod system. | Homework 1: Rod system analysis |
| To be able to analyze the material point and solid kinematics. | Test 2: Material point and solid kinematics |
| To be able to use the inertial navigation theory in practice. | Homework 2: Inertial navigation algorithm |
| To be able to analyze the dynamics of a material point solid. | Test 3: Dynamics of a material point solid |
| To be able to solve the problem of statics undefined rod system. | Homework 3: Statics undefined rod systems analysis |
| To be able to solve the problem of a shaft torsion. | Homework 4: Shaft at torsion |
| To be able to solve the problem of a beam bending. | Homework 5: Beam bending |
| To be able to use electrical measurement of a strain in practice. | Laboratory work: Electrical measurement of a strain |

*Study subject structure*

| Part | CP | ECTS | Hours per Week | | | Tests | | |
|---|---|---|---|---|---|---|---|---|
| | | | Lectures | Practical | Lab. | Test | Exam | Work |
| 1. | 2.0 | 3.0 | 1.0 | 0.5 | 0.5 | | * | |
| 2. | 2.0 | 3.0 | 1.0 | 0.5 | 0.5 | | * | |