



***The physical basis of experimental methods used in mechanics***

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*Objectives of the lectures:*

- to show that the foundation of determining any physical quantity that characterizes an object is a certain phenomenon described by the laws of physics,
- to encourage those who are engaged in modelling of processes to confront their introduced assumptions with the results of experiments,
- to analyze examples of non-destructive experimental test methods taking into account the importance of these methods in modern mechanic.

**Course content**

**1. Introduction:**

- the structure of modern scientific research,
- the concept of experimental method in natural sciences and technology,
- experimental methods in the pre-scientific world,
- Galileo Galilei as a precursor of modern experimental methods in mechanics,
- metrology and its beginnings, International System of Units.

**2. Material properties determining its response to mechanical loading:**

- the definitions of stress and strain and a choice of measure for these quantities,
- investigation of a material subjected to uniaxial loading,
  - a) yield point and methods of its determination,
  - b) the dependence of yield point on strain rate,
  - c) Young's modulus and methods of its determination.

**3. Energy balance in a material deformation process:**

- physical quantities describing a thermodynamic state of a deformed material: internal energy, entropy, and free energy,
- energy storage process during plastic deformation,
- stored energy and experimental methods of its determination,
- the concept of energy storage rate as a measure of the plastic work partition into the stored energy and heat at each instant of the deformation process.

**4. Instability of plastic deformation:**

- Considère's criterion and its limitations,
- loss of energy storage rate in the area of plastic deformation localization as an indicator of plastic deformation instability,
- finding the point of plastic deformation instability based on the determination of the energy storage rate during a material deformation process.

**5. Non-destructive experimental test methods:**

- physical phenomena used in non-destructive test methods: basics of ultrasonic methods, eddy currents and non-contact measurement of temperature fields,
- the importance of non-destructive test methods in modern mechanics.

**The total number of lecture hours: 30, laboratory exercises: 0 hours, self-teaching: 40, direct tutoring and consultations: 10 hours,**

**ECTS Points: 3**