

### **Mechanics of coupled fields in materials and structural members**

The course "Mechanics of Coupled Fields in Materials and Structural Members" is designed for PhD students of second year who is studying natural sciences in ukrainian universities.

The main aim of the course is to introduce the thermodynamic framework for derivation of constitutive equations describing the complex both linear and nonlinear behavior of materials with accounting for couplings of thermal and mechanical fields. In order to obtain a more fundamental basis for constitutive modeling, it seems interesting to investigate whether thermodynamics may provide this basis. Thermodynamics deals with relations between heat and mechanical work and is based on the two fundamental laws of nature, the First and the Second Law of Thermodynamics.

The course proposed shows that it turns out to be possible to derive constitutive theories from thermodynamics. So the some fundamental results of thermodynamics are presented. Then a brief overview of the basic concepts and methods of continuum mechanics is given there. Various concepts like temperature, heat, entropy, etc. are introduced as well. We will confine our study to mechanical and heat processes and exclude electric, magnetic, chemical and diffusion processes. Considerable attention is paid to the thermodynamic principles, the rheological models and the construction of different theories.

Then the main approaches to construction of the models of continuum behavior on the basis of the modern concepts of thermodynamics of irreversible processes are discussed. The main attention is paid to the common features and different aspects of the material response with making use of the concepts of continua with fading memory, rate dependent materials and materials with internal state variables.

To illustrate the theories capability, several examples of coupled thermomechanical response of the materials and structural elements are presented (dissipative heating of viscoelastic, elastoviscoplastic structures under cyclic loading as well as thermomechanical wave effects under thermal pulse loading of metal members).

**Кількість кредитів:** 4

**Форма контролю:** іспит

**Викладач:** Жук Я.О., д-р ф.-м. н., професор, завідувач кафедри теоретичної і прикладної механіки.