

Introduction

In this selection you can find the papers, presented either by P.A. Zhilin or by his co-authors at the APM Summer-School Conference in the period from 1994 to 2005. The book is issued in two volumes: the first one contains articles in Russian, the second one contains articles in English. In both volumes the articles are listed in chronological order. The range of questions discussed is wide. It includes fundamental laws of mechanics, direct tensor calculus, rigid body dynamics, nonlinear rod theory, general theory of non-linear media, including plasticity, consolidating granular media, phase transitions, as well as piezoelectricity, ferromagnetism, electrodynamics and quantum mechanics. At first sight it seems that the papers are not related one to another. But this is not so. Let us show a few examples. Rigid body oscillator, introduced in the article related to the absolute rigid body dynamics, is used further as fundamental model when constructing inelastic media theory, piezoelectricity theory, and theory of magnetoelastic materials. Methods of description of the spinor motion, based on use of the direct tensor calculus, are used and developed both for solving rigid body dynamics problems and for solving nonlinear rod theory problems. The same methods are used when constructing various continuum models, which take into account rotational degrees of freedom. The symmetry theory and tensor invariant theory, which are presented in the book, dedicated to this topic, are being actively used and developed when constructing rod theory, as well as for other continuum theories. Two papers are dedicated to the formulation of fundamental laws of the Eulerian mechanics — mechanics of a general body, consisting of particles with rotational degrees of freedom. All continuum theories, presented in the digest, including electrodynamics, are built adhering to the same positions based on the fundamental laws of mechanics. When building continuum models both for elastic and inelastic media, the theory of strains is used, which is based on the idea of using the reduced energy balance equation for defining measures of deformation. By the elementary examples of discrete systems mechanics the notions of internal energy, chemical potential, temperature and entropy are introduced. Definition of these quantities is given by means of pure mechanical arguments, which are based on using special mathematical formulation of energy balance equation. The same method of introducing the basic thermodynamics notions indicated above is used when building different continuum theories. In fact the selected papers of P.A. Zhilin represent the method for constructing continuum theories with rotational degrees of freedom together with the necessary mathematical apparatus, as well as examples of using the mentioned theories when describing different physical phenomena. Among others, the first volume of the digest includes two papers, dedicated

to the fundamental laws of mechanics, which were written with big time interval, and two articles on the rod theory, which were also written in the different periods of time. The Reader can take advantage of following the development of scientific ideas. The first paper dedicated to the fundamental laws of mechanics, is a quite perfect, logically rigorous theory. Nevertheless, after many years, author returns to this topic. The aim was not to change something in the original variant, but to complete it by including in it thermodynamical ideas. The mentioned above can equally be pertained to the two papers on the rod theory. Not every physical theory permits including of new notions in it. Often, when needed to describe a new phenomenon, one is forced to reject an old theory and build a new one instead. The theories presented in this selection have an ability to be developed. This is their great advantage, and that is one of the important reasons why they attract attention of researchers.

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