Theory of mixtures

2/0 Zk

Recommended prerequisites: Single-component continuum mechanics and thermodynamics

Sylabus

1. Introduction

2. Mixtures in geophysical applications
Hierarchy of mixture models and their examples, Class I mixtures - diffusion models (Fick’s law, salinity transport, water/air pollution), chemical reactions, phase transitions (Earth mantle mineralogy, phase rule, melting), Class II mixtures - mechanical coupling between phases (Darcy law, porous flow, glacier hydrology), Class III mixtures - full model (plasmas, pyroclastic flows)

3. Fick and Cahn-Hilliard Navier-Stokes-Fourier model

4. Allen-Cahn model
Class I: Stefan’s equations and Allen-Cahn Navier-Stokes-Fourier problem.

5. Darcy’s equation and its various generalizations
Class II: Darcy’s law. Brinkman’s equations. Derivation of a class II euqations for the assumptions imposed on the mixture as a whole.

6. Basic mechanical applications
Forces acting on a moving sphere in a fluid, Constitutive ansatz for the interaction force in fluid-solid mixture (virtual mass force, Stokes drag, Besset force, lift force, Magnus effect)

7. Continuum theory of mixtures revisited
Generalised Reynolds transport theorem, General form of the balance laws in the bulk and on singular surfaces, Interface conditions, Partial balance laws and balance laws for the mixture as a whole, Mixture properties in terms of the properties of components

8. Alternative approach - multiphase theory
Multi-phase approach based on volume averaging, Multi-phase balances of mass, momentum and
energy in a two-component system

9.-11. Entropy principles and constitutive theories for mixtures


Lectures will take place at 9:00 K7, Wed.

RNDr. Ondřej Souček, Ph.D.
Prof. RNDr. Josef Málek, DSc.

Literature: