Response to question 2

The general, conceptual, motivation of the linear fluid model is to formulate simple but not trivial model which is (in equilibrium) equivalent to the classical (equilibrium) thermodynamics and can represent non-Newtonian fluids, heat conduction by Fourier law or diffusion by Fick laws. In the same time the model is not restricted to linearity in chemical reactions (naturally includes typically non-linear chemical kinetics) and enables to prove local equilibrium (instead of using it as an *a priori* hypothesis). This is probably the most "complex" model which still retains the validity of relationships of classical thermodynamics. In other words, this is the model which shows (the limits of) the extension of classical thermodynamics, familiar to chemists and chemical engineers, to non-equilibrium.

The mathematical motivation originates from the model of nonsimple fluid - cf. equation (3.127) in the book. Final constitutive equations of this model are given by (3.171)-(3.173). In equilibrium, the responses of this model depend merely on density and temperature, because the only dependencies on the other quantities $(\mathbf{h}, \mathbf{D}, \mathbf{g})$ vanish in equilibrium - cf. (3.170), (3.163) and (3.172), (3.173), respectively. It can therefore be expected, that as a first non-equilibrium approximation the dependence (of the non-equilibrium quantities $\mathbf{q}, \mathbf{T}_N$) on $\mathbf{h}, \mathbf{D}, \mathbf{g}$ would be linear. In the same time, these dependencies should be expressed as isotropic functions - their forms are given by (A.58) and (A.68) (remember that $\mathbf{T}_N$ is a symmetric tensor). Consequently, (3.183) and (3.184) are the linear representations. In this sense, the linear fluid model can be viewed as a result of "linearization around equilibrium" although, in fact, no true first-order expansion of functions was employed (remember that the dependence on ρ and T was not limited to linearity).

The model of mixture of linear fluids is a straightforward extension of the model of single linear fluid - just the number of independent quantities is higher due to the occurrence of partial quantities. The scalar responses are generally represented as shown by (A.57) or (A.67), cf. (4.130)-(4.133), the remaining ones as shown by (A.58) or (A.68), cf. (4.136)-(4.138).