

# Contents

<b>Introduction</b> . . . . .	v
<b>1 The main asymptotic modes of suspension motion and associated model boundary-value problems</b> . . . . .	1
1.1 Microscopic model of suspension motion . . . . .	1
1.2 A priori estimates for solution of the problem and main asymptotic modes of suspension motion . . . . .	7
1.3 Method of particle fixation: Three main model problems . . . . .	13
<b>2 Homogenized equations of suspension motion in frozen particles mode</b> .	19
2.1 Asymptotic behavior of the solution of model problem $A$ . . . . .	19
2.2 The resolvent convergence of model problem $A$ . . . . .	45
2.3 Uniform estimates of derivatives of the solution of the initial problem	50
2.4 Homogenized equations of perturbation of the carrier fluid by small solid particles moving in frozen particles mode . . . . .	58
<b>3 Suspension viscosity tensor</b> . . . . .	69
3.1 Calculation of viscosity tensors for structures close to periodic . . . . .	69
3.2 Equivalent definition of the viscosity tensor . . . . .	80
3.3 Asymptotics of viscosity tensors at weak concentrations . . . . .	86
3.4 Mean value of the viscosity tensor with random distribution of diameters and orientations of particles . . . . .	97
<b>4 Closure of the homogenized system of equations for suspension motion in frozen particles mode</b> . . . . .	103
4.1 On the effect of viscous incompressible fluid flow on a particle . . . . .	103
4.2 On the motion of a single particle in viscous incompressible fluid flow	109
4.3 Evolution equation of the mean orientation vector . . . . .	111
4.4 Closed system of equations for suspension motion in frozen particles mode . . . . .	116
4.5 On existence of generalized solutions of the initial–boundary-value problem for closed systems of homogenized equations of suspension motion of axisymmetric particles . . . . .	119
<b>5 Hydrodynamics of suspensions in strong external fields</b> . . . . .	135
5.1 Asymptotic behavior of the solution of model problem $C$ . . . . .	135

5.2	Asymptotic behavior of the solution of model problem $A$ with external moments . . . . .	150
5.3	Nonstandard model of hydrodynamics of suspension of oriented particles . . . . .	154
<b>6</b>	<b>Homogenized equations of suspension motion in filtering particles mode</b>	<b>161</b>
6.1	Asymptotic behavior of the solution of model problem $B$ . . . . .	161
6.2	Probabilistic distribution of particles . . . . .	179
6.3	Perturbation of viscous incompressible fluid by small solid particles moving in filtration mode . . . . .	187
6.4	Closed system of equations of suspension motion in filtering particles mode . . . . .	190
6.5	On existence of global generalized solutions of the initial–boundary-value problem for closed systems of equations of suspension motion in filtration mode . . . . .	193
<b>7</b>	<b>Homogenized model of a complex fluid with microstructure</b> . . . . .	<b>197</b>
7.1	Formulation of the problem . . . . .	197
7.2	Mesoscopic characteristics of microstructure and statement of the main result . . . . .	201
7.3	Variational statement of the problem and its homogenization . . . . .	205
7.4	Analytical properties of the limiting tensor $\{a_{npqr}(x, \lambda)\}$ . . . . .	212
7.5	Analytical properties of solutions of boundary-value problems (7.3.1)–(7.3.5) and (7.3.18)–(7.3.19) . . . . .	220
7.6	End of proof of Theorem 7.2.1 . . . . .	222
7.7	Periodic structure . . . . .	225
<b>8</b>	<b>Two-phase homogenized model of motion of a complex fluid with microstructure</b> . . . . .	<b>235</b>
8.1	Formulation of the problem . . . . .	235
8.2	Local quantitative characteristics of the system of interacting particles and statement of the main result . . . . .	237
8.3	Discrete analogue of the Korn inequality . . . . .	239
8.4	Variational statement of the problem . . . . .	242
8.5	Proof of the main theorem in the variational formulation . . . . .	245
8.6	Analytical properties of solutions of boundary-value problems (8.4.1)–(8.4.5) and (8.4.10)–(8.4.12). End of proof of main theorem . . . . .	261
8.7	Periodic structure . . . . .	263
	<b>References</b> . . . . .	<b>265</b>
	<b>Index</b> . . . . .	<b>273</b>