

---

## Contents

<b>Abbreviations .....</b>	XV
<b>Symbols .....</b>	XVII
<b>1 Introduction .....</b>	1
1.1 Heat Transfer Processes Containing Periodic Oscillations .....	1
1.1.1 Oscillation Internal Structure of Convective Heat Transfer Processes .....	1
1.1.2 Problem of Correct Averaging the Heat Transfer Coefficients .....	3
1.2 Physical Examples .....	6
1.3 Numerical Modeling of Conjugate Convective–Conductive Heat Transfer .....	10
1.4 Mechanism of Hydrodynamic Oscillations in a Medium Flowing Over a Body .....	12
1.4.1 Van Driest Model .....	12
1.4.2 Periodic Model of the Reynolds Analogy .....	13
1.4.3 Model of Periodical Contacts .....	15
1.5 Hydrodynamic HTC .....	18
1.6 Previous Investigations of Heat Transfer Processes with Periodic Intensity .....	20
1.7 Analytical Methods .....	20
References .....	21
<b>2 Construction of a General Solution of the Problem .....</b>	27
2.1 Boundary Value Problem for the Heat Conduction Equation .....	27
2.2 Spatial and Temporal Types of Oscillations .....	30
2.3 Interrelation between the Two Averaged Coefficients of Heat Transfer .....	31
2.4 Dimensionless Parameters .....	34

XII      Contents

2.5 Factor of Conjugation: An Analysis of Limiting Variants . . . . .	35
References . . . . .	36
<b>3 Solution of Characteristic Problems . . . . .</b>	<b>37</b>
3.1 Construction of the General Solution . . . . .	37
3.2 Harmonic Law of Oscillations . . . . .	39
3.3 Inverse Harmonic Law of Oscillations . . . . .	43
3.4 Delta-Like Law of Oscillations . . . . .	53
3.5 Step Law of Oscillations . . . . .	55
3.6 Comparative Analysis of the Conjugation Effects (Smooth and Step Oscillations) . . . . .	68
3.7 Particular Exact Solution . . . . .	69
References . . . . .	70
<b>4 Universal Algorithm of Computation of the Factor of Conjugation . . . . .</b>	<b>73</b>
4.1 Smooth Oscillations (Approximate Solutions) . . . . .	73
4.2 BC on a Heat Transfer Surface (Series Expansion in a Small Parameter) . . . . .	75
4.3 Derivation of a Computational Algorithm . . . . .	77
4.4 Phase Shift Between Oscillations . . . . .	80
4.5 Method of a Small Parameter . . . . .	83
4.6 Application of the Algorithm for an Arbitrary Law of Oscillations . . . . .	85
4.7 Filtration Property of the Computational Algorithm . . . . .	91
4.8 Generalized Parameter of the Thermal Effect . . . . .	92
4.9 Advantages of the Computational Algorithm . . . . .	93
References . . . . .	93
<b>5 Solution of Special Problems . . . . .</b>	<b>95</b>
5.1 Complex Case of Heating or Cooling . . . . .	95
5.2 Heat Transfer on the Surface of a Cylinder . . . . .	102
5.3 Heat Transfer on the Surface of a Sphere . . . . .	103
5.4 Parameter of Thermal Effect for Different Geometrical Bodies . . . . .	104
5.5 Overall ATHTC . . . . .	105
5.5.1 Overall EHTC . . . . .	105
5.5.2 Bilateral Spatiotemporal Periodicity of Heat Transfer (A Qualitative Analysis) . . . . .	108
References . . . . .	110
<b>6 Step and Nonperiodic Oscillations of the Heat Transfer Intensity . . . . .</b>	<b>111</b>
6.1 Asymmetric Step Oscillations . . . . .	111
6.2 Nonperiodic Oscillations . . . . .	117
References . . . . .	120

<b>7</b>	<b>Practical Applications of the Theory</b>	121
7.1	Model Experiment	121
7.2	Dropwise Condensation	122
7.3	Nucleate Boiling	126
7.3.1	Theory of Labuntsov	126
7.3.2	Periodic Model of Nucleate Boiling	129
	References	136
<b>A</b>	<b>Proof of the Fundamental Inequalities</b>	139
A.1	Proof of the First Fundamental Inequality	139
A.2	Proof of the Second Fundamental Inequality	145
<b>B</b>	<b>Functions of the Wall Thickness</b>	147
B.1	Spatial Type of Oscillations	148
B.2	Temporal Type of Oscillations	148
<b>C</b>	<b>Infinite Chain Fractions</b>	151
C.1	Fundamental Theorems of Khinchin	151
C.2	Generalization of the Third Theorem of Khinchin	152
<b>D</b>	<b>Proof of Divergence of the Infinite Series</b>	155
D.1	Spatial Type of Oscillations	155
D.2	Temporal Type of Oscillations	156
<b>E</b>	<b>Functions of Thickness for Special Problems</b>	159
E.1	Heat Transfer from the Ambience	159
E.2	Heat Transfer from an External Semi-Infinite Body	160
	<b>Index</b>	161