

<b>1</b>	<b>BASIC CONCEPTS</b>	<b>-1</b>
1.1	Introductory Remarks	1
1.2	Perturbation Quantity	2
1.2.1	Steady Conduction in a Slab with Variable Thermal Conductivity	2
1.2.2	Plane Couette Flow with Variable Viscosity	3
1.2.3	Laminar Mixed Convection in a Vertical Pipe	4
1.2.4	Freezing of a Saturated Liquid in Semi-Infinite Region	6
1.2.5	Two-dimensional Steady Conduction in a Body of Irregular Shape	7
1.2.6	Laminar Natural Convection from a Thin Vertical Cylinder	9
1.2.7	Unsteady Heat Transfer for Laminar Flow over a Flat Plate	10
1.2.8	Cooling of a Lumped System with Variable Heat Transfer Coefficient	12
1.3	Parameter Perturbation and Coordinate Perturbation	13
1.4	Choice of Perturbation Quantity	13
1.5	Multiple Perturbation Quantities	14
1.5.1	Convecting-Radiating Fin with Variable Thermal Conductivity	14

1.6	Gauge Functions	15
1.7	Asymptotic Expansions	18
1.8	Regular Perturbation and Singular Perturbation	18
2	<b>REGULAR PERTURBATION EXPANSIONS</b>	21
2.1	Introduction	21
2.2	An Algebraic Equation	21
2.3	A Transcendental Equation	23
2.4	Cooling of a Lumped System with Variable Specific Heat	25
2.5	Plane Couette Flow with Variable Viscosity	27
2.6	Laminar Mixed Convection in a Vertical Pipe	29
2.7	Freezing of a Saturated Liquid in Semi-Infinite Region	31
2.8	Two-dimensional Steady Conduction in a Body of Irregular Shape	35
2.9	Laminar Natural Convection from a Thin Vertical Cylinder	37
2.10	Unsteady Heat Transfer for Laminar Flow over a Flat Plate	39
2.11	Entrance Region Heat Transfer in a Tube	42
2.12	Convecting-Radiating Fin with Variable Thermal Conductivity	44
2.13	Convecting-Radiating Cooling of a Lumped System with Variable Specific Heat	46
	Problems	49
3	<b>SINGULAR PERTURBATION EXPANSIONS</b>	57
3.1	Introduction	57
3.2	An Algebraic Equation	58
3.3	A Transcendental Equation	59
3.4	A First-Order Differential Equation	60
3.5	Radiating Heat Shield	62
3.6	Melting of a Finite Slab	64
3.7	Inward Spherical Solidification	68
3.8	Cooling of a Lumped System with Variable Heat Transfer Coefficient	72
	Problems	73
4	<b>METHOD OF STRAINED COORDINATES</b>	77
4.1	Lighthill's Technique	77
4.1.1	A First-Order Differential Equation	78
4.1.2	Melting of a Finite Slab	82
4.1.3	Inward Spherical Solidification	84
4.2	Pritulo's Method	93
4.2.1	A First-Order Differential Equation	93
4.2.2	Melting of a Finite Slab	95
4.2.3	Inward Spherical Solidification	96

4.3	Martin's Approach	97
4.3.1	A First-Order Differential Equation Problems	98
		99
<b>5</b>	<b>METHOD OF MATCHED ASYMPTOTIC EXPANSIONS</b>	<b>103</b>
5.1	Introduction	103
5.2	Heat Transfer from a Moving Rod	103
5.3	Heat Conduction in an Insulated Cable	109
5.4	Freezing in a Finite Slab	114
5.5	Interaction of Radiation with Natural Convection	119
5.6	Natural Convection at High Prandtl Number	124
5.7	Convection in a Pipe Problems	131
		133
<b>6</b>	<b>EXTENSION, ANALYSIS, AND IMPROVEMENT OF PERTURBATION SERIES</b>	<b>139</b>
6.1	Introduction	139
6.2	Extension of Series	140
6.2.1	Heat Transfer in a Radiating Fin	140
6.2.2	Transient Conduction into a Variable Conductivity Semi-Infinite Medium	143
6.2.3	Boundary-Layer Flow Longitudinal to a Cylinder	144
6.2.4	Heat Transfer in Falkner-Skan Flow	147
6.2.5	Flat Plate Heat Transfer with Variable Freestream Velocity	149
6.2.6	Natural Convection from a Nonisothermal Vertical Plate	153
6.2.7	Miscellaneous Examples	155
6.3	Analysis of Series	158
6.3.1	Pattern of Signs	158
6.3.2	Significance of Nearest Singularity	159
6.3.3	Location and Nature of Singularities	159
6.3.4	Examples of Domb-Sykes Plot	161
6.4	Improvement of Series	162
6.4.1	Euler Transformation	166
6.4.2	Extraction of Singularity	168
6.4.3	Reversion of Series	170
6.4.4	Shanks Transformation	172
6.4.5	Padé Approximants Problems	176
		180
	References	185
	Bibliography: Perturbation Literature in Heat Transfer	191
	Index	197