Contents

	Glossary of Notation	ix
	Introduction	1
1.	General Procedure for Obtaining the Macroscopic Transport Equations from the Boltzmann Equations for a Gas	4
2.	Boltzmann Equation for Photons	10
	2.1 Photon-Collision Integral with Scattering Neglected2.2 Scattering Contribution to the Photon-Collision Integ-	11
	ral	17 23
3.	Macroscopic Radiative Transport Equations	28
	3.1 General Equations3.2 Procedure for Combining Matter and Radiative Parts to Obtain the Total Energy and Momentum Trans-	28
	port Equations	33
	to Total Energy Density and Pressure are Small $(E_{\tau} \ll E_{m}, P_{\tau} \ll P_{m})$	37
4.	General Solution to the Radiative Transport Equation	40
5.	Specific Applications of the Solution to the Radiative Transport Equation	44
	5.1 Interior of an Optically Thick Medium; $(\tau_{\nu}' - \tau_{\nu} \rho') \simeq$	44
	$[q-q_0]K_{\nu}\gg 1.$ 5.2 Interior of an Optically Thin Medium; $[q-q_0]K_{\nu}\ll 1$	49
	5.3 Radiation from a Distant Source	50
	5.3.1 Optically Thick Distant Source: $K_{A\nu}l(\mathbf{s}) \gg 1$	51
	5.3.2 Optically Thin Distant Source; $K_{A\nu}l(s) \ll 1$	52
	5.4 The Effect of Scattering on Results for Optically Thick and Optically Thin Gases	53

viii CONTENTS

6. Radiative Transport Problems Involving One-Spatial Dimension	63
7. Discussion of the Concepts of Use in the Treatment of Radiation at a Surface; Absorptivity, Reflectivity, Transparency, and Emissivity	70
8. Applications of the Surface Concepts	86
8.1 Derivation of the Formulas for Emissivity, Transparency, and Absorptivity of a Gas	86
8.2 Use of Emissivity and Reflectivity Coefficients in the	
Transport Equations	92 99
9. Non-Equilibrium Radiation	105
10. Conditions Required for Local Thermodynamic Equilibrium	114
10.1 Conditions for LTE in a Non-Optically Thick Gas10.1.1 Criteria for the Gas to be Collision Dominated.10.1.2 Conditions on Space and Time Variations of Tem-	117 117
perature and Density	126 128
Appendix A. Boltzmann Collision Integral	132
Appendix B. Lorentz Transformation of Radiative Energy and Momentum Transport Equations	138
Appendix C. Effect of Solving the Radiative Transport Equation in a Non-Inertial System	146
Appendix D. Determination of Rate Equations from the Boltzmann Equation	153
References	171
Subject Index	