

Contents

1.	Introduction	1
1.1	The Structure of the Book	3
2.	Basic Relations	7
2.1	Basic Laws of Plasma Electrodynamics	7
2.2	Basic Equations for Modelling Gas Discharges	13
2.2.1	Kinetic-Model Equations	13
2.2.2	Fluid-Model Equations	20
3.	Surface-Wave Propagation in Homogeneous Plasmas	29
3.1	Remarks on Classification	30
3.2	Single Plane Interface	33
3.2.1	Case of Weak Collisions ($\omega \gg \nu$)	36
3.2.2	Case of Strong Collisions ($\nu \gg \omega$)	44
3.2.3	Semi-Bounded Plasmas Overlain by a Dielectric or a Plasma	46
3.2.4	Influence of the Thermal Motion of the Electrons	48
3.3	Plasma Slabs and Plasma Columns	50
3.3.1	Plasma Slabs: Planar Waveguides	52
3.3.2	Plasma Columns: Cylindrical Waveguides	58
4.	Surface-Wave Propagation in Inhomogeneous Plasmas	75
4.1	Main Aspects Treated in this Chapter	77
4.2	Inhomogeneity in the Transverse Direction	79
4.2.1	Wave-Field Equations for Plane Geometry	79
4.2.2	Influence of Thermal Electron Motion on the Resonance Absorption of Electromagnetic Surface Waves	82
4.2.3	Surface Wave Propagation Along an Inhomogeneous Plasma Slab	84
4.2.4	Surface Wave Propagation Along a Radially Inhomogeneous Plasma Column	96
4.3	Inhomogeneity in the Longitudinal Direction	107

4.3.1	Single Interface	108
4.3.2	Layered Structures	114
4.3.3	Cylindrical Geometry	116
4.3.4	Generalized Procedure for Obtaining the Geometrical-Optics Solutions	118
4.3.5	Numerical Results for a Single Interface and for Cylindrical Waveguides	125
4.4	Calculations with Both Transverse and Longitudinal Inhomogeneities	133
5.	Fluid Theory	
	of Surface-Wave-Produced Plasmas	139
5.1	Surface-Wave-Sustained Discharges: Nonlinear Systems Unifying Plasma and Wave Field	140
5.2	The Set of Equations	145
5.3	Ionization Nonlinearity	146
5.3.1	Electron Temperature in Terms of the Maintenance Field Intensity	146
5.3.2	Power Absorbed on Average per Electron	150
5.3.3	Ionization Frequency in Terms of the Maintenance Field Intensity	150
5.3.4	Plasma Density Expressed in Terms of the Maintenance Field Intensity	151
5.4	The Electrodynamic Part of the Problem of Maintenance of a Waveguided Discharge	170
5.5	Self-Consistent Axial Structure	171
5.5.1	Recombination-Controlled Regime	171
5.5.2	Diffusion-Controlled Regime	172
5.5.3	Comparison of the Axial Structures of Discharges in Diffusion- and Recombination-Controlled Regimes .	180
5.6	Axial Density Profiles	182
5.6.1	General Relations	182
5.6.2	Discharges Maintained in a Diffusion-Controlled Regime by Joule Heating in the Volume	186
5.6.3	Discharges Maintained by Joule Heating in the Plasma Volume and in Regions of Resonance Absorption	190
6.	Kinetic Numerical Modelling	205
6.1	Nonlocal Model	206
6.1.1	Boltzmann's Equation	207
6.1.2	Complementary Relations	212
6.1.3	Mean Power Absorbed per Electron	215
6.1.4	Axial Structure	216
6.1.5	Results	217

6.1.6	Axial Changes of Electric-Field Intensity	224
6.1.7	Influence of Ponderomotive-Force Effects	226
6.2	Local Approach	226
6.2.1	Set of Equations	227
6.2.2	Essential Features	228
6.3	Transition Regime	230
7.	Experimental Aspects	237
7.1	Experimental Conditions	237
7.2	Diagnostic Methods	240
7.2.1	Radiophysics Diagnostic Methods	243
7.2.2	Probe Diagnostics	246
7.2.3	Microwave Diagnostics	248
7.2.4	Optical Spectroscopy Methods	248
7.3	Summary of Observations	249
7.3.1	Observations on Basic Features	249
7.3.2	Observations Relevant to Features of Self-Consistency .	255
7.4	Open Questions and Related Areas of Research	263
7.5	Applicational Aspects	263
	References	267
	Subject Index	287