

Contents

Preface	ix
Acknowledgements	x
Author biography	xi
Symbols	xii
Acronyms	xiii
1 Plasmas in space and in the laboratory	1-1
1.1 Plasmas in nature and in the laboratory	1-2
1.2 Solar plasmas	1-6
1.3 The Earth's magnetosphere and ionosphere	1-8
1.4 Plasma physics and space technology	1-10
1.5 Commentaries and further reading	1-13
References	1-14
2 Ionized gases and plasmas	2-1
2.1 Collisions and elementary processes	2-2
2.2 Collision length and time scales	2-5
2.3 The plasma state of condensed matter	2-10
2.4 Additional considerations	2-11
2.5 Commentaries and further reading	2-12
References	2-13
3 Basic kinetic theory of neutral gases	3-1
3.1 The probabilistic description of gases	3-1
3.2 The Maxwell–Boltzmann distribution	3-2
3.3 Averaging over distributions	3-6
3.4 Rate constant and collision frequencies	3-10
3.5 The neutral gas in a force field	3-14
3.6 Equipartition of energy	3-15
3.7 Commentaries and further reading	3-17
References	3-17
4 The ideal plasma parameters	4-1
4.1 The ideal Maxwellian plasma	4-1
4.2 Elementary processes and steady equilibrium states	4-4

4.3	Energy thermalization	4-5
4.4	Electric field shielding	4-8
4.5	The plasma parameters	4-10
4.5.1	The Debye length	4-12
4.5.2	The plasma frequency	4-17
4.5.3	The plasma and coupling parameters	4-20
4.5.4	Magnetized plasmas	4-22
4.5.5	Magnetic shielding	4-23
4.6	Commentaries and further reading	4-25
	References	4-26
5	Particle collisions in plasmas	5-1
5.1	The differential cross section	5-2
5.2	The effect of velocity distributions	5-4
5.3	Elastic collisions in plasmas	5-5
5.3.1	Approximate cross section for short-range encounters	5-9
5.3.2	The collisions between charged particles	5-10
5.4	The momentum transfer cross section	5-11
5.5	Electric potential screening	5-12
5.6	Commentaries and further reading	5-14
	References	5-15
6	The elementary plasma processes	6-1
6.1	The elastic collisions of electrons	6-3
6.2	The inelastic collisions of electrons	6-5
6.2.1	Excitation	6-5
6.2.2	Ionization	6-6
6.2.3	Electron losses	6-11
6.2.4	Electron and ion recombination	6-12
6.2.5	Electron attachment and detachment	6-13
6.3	The collisions of ions and molecules	6-13
6.4	Interaction of charges with solid surfaces	6-17
6.4.1	Thermionic electron emission	6-18
6.4.2	Secondary electron emission by ion impact	6-18
6.4.3	Secondary electron emission by electron impact	6-20
6.5	Commentaries and further reading	6-22
	References	6-23
	Appendix	A-1