

CONTENTS

1 Introduction	1
1 Characteristic frequencies and lengths in a magnetized plasma	1
2 High frequency heating of thermonuclear plasmas	6
2 Plasma electrodynamics	12
3 Maxwell's equations in plasmas	12
4 The constitutive relation	17
5 Characteristic waves of the uniform plasma	24
6 Properties of the dielectric tensor	32
7 The initial value problem for Maxwell's equations	36
8 Radiation from a localized source	43
9 Energy relations	50
Bibliography	56
3 Elementary plasma kinetic theory	58
10 Vlasov equation for the self-consistent field	58
11 The Fokker-Planck equation	67
12 Macroscopic plasma description and MHD limit	84
Bibliography	91
4 The hot-plasma dielectric tensor	93
13 Solution of the linearized Vlasov equation	93
14 The dielectric tensor of a Maxwellian plasma	104
15 The dielectric tensor of non-Maxwellian plasmas	116
16 The relativistic dielectric tensor	133
A4.1 Unperturbed orbits in a uniform static magnetic field	151
A4.2 Bessel functions identities	153
A4.3 The relativistic plasma dispersion functions	156
Bibliography	162
5 Waves in a cold plasma	164
17 The cold-plasma approximation	164
18 The dispersion relation of the cold plasma	174
19 Cutoffs and resonances	185
20 Parallel and perpendicular propagation	192
21 Cold-plasma waves in the electron frequency range	202
22 Cold-plasma waves in the lower hybrid frequency range	221
23 Cold-plasma waves at low frequencies	235
Bibliography	251

6	Waves in a hot plasma	254
24	The hot-plasma dispersion relation	254
25	Parallel propagation in a hot plasma	262
26	The finite Larmor radius approximation	269
27	Hot-plasma waves at high frequencies	282
28	Hot-plasma waves at low frequencies	302
	Bibliography	322
7	The electrostatic and fluid approximations	324
29	The electrostatic approximation	324
30	Electron and ion Bernstein waves	331
31	The electrostatic approximation in the lower hybrid frequency range	344
32	The ion acoustic branch	354
33	Moment equations description of plasma waves	359
34	Electrostatic instabilities	369
	Bibliography	388
8	Linear wave-particle interactions	393
35	Resonant wave-particle interactions in a uniform plasma	393
36	Elementary description of h.f. current drive	413
37	Landau damping of a monochromatic wave	422
38	Wave damping and plasma heating	439
	Bibliography	454
9	Collisionless stochasticity	459
39	Particle motion in finite amplitude electrostatic waves	459
40	Particle-wave interactions in a uniform magnetic field	478
41	Stochastic ion heating by lower hybrid waves	490
	Bibliography	505
10	Quasilinear theory and current drive	508
42	The quasilinear approximation	508
43	Quasilinear description of ion cyclotron heating	517
44	Current drive by lower hybrid and Alfvén waves	544
45	The ‘adjoint’ evaluation of the h.f. current drive efficiency	561
A.10.1	Integrals of Legendre polynomials	574
	Bibliography	577
11	Nonlinear effects associated with h.f. heating	582
46	The mode-coupling formalism	582
47	Parametric instabilities	597
48	Evaluation of the coupling coefficients	607
49	The dipole approximation	622
	Bibliography	637
	Index	643