

Contents

<i>Preface to the paperback edition</i>	ix
<i>Preface</i>	xi
Introduction	1
1 General remarks	5
2 General properties of the near-Earth and interplanetary plasma	10
2.1 Structure and properties of the plasma at different distances from the Earth	11
2.2 Distribution of charged-particle density inside and outside the plasmasphere	15
2.3 Structure of the magnetic field in the near-Earth plasma	24
3 Fundamental equations	28
4 Refractive indexes for a cold magnetoplasma	35
4.1 Permittivity-tensor elements for a collisional plasma	35
4.1.1 Tensor elements taking into account collisions between different kinds of charged particles	37
4.1.2 Effect of collisions between like particles (electrons, or ions of one kind), in the ELF range $0 \leq \omega \simeq \Omega_{\text{H}}$	42
4.2 Formulas for \tilde{n}_{12}^2 in the presence of ions of one kind over the entire frequency range $0 \leq \omega \rightarrow \infty$	47
4.3 Properties of the different branches of waves	53
4.3.1 Polarization coefficients	53
4.3.2 Refractive indexes. Resonances. Classification of the waves	56
4.4 Refractive indexes for a multicomponent plasma	65
4.4.1 Properties of n_{12}^2 in a collisionless plasma	65
4.4.2 Relationships for n_{12} and κ_{12} in a collisional plasma	70
5 Refractive indexes and attenuation factors in a warm plasma	82
5.1 Tensor elements and values of n_{12}^2 allowing for the thermal motion of the particles ($T_e \neq T_i \neq 0$)	83

5.2 High-frequency, Langmuir, and low-frequency waves ($\omega \gtrsim \omega_0, \omega_H; \omega_L \ll \omega \leq \omega_H$)	84
5.2.1 Refractive-index formulas	85
5.2.2 'Kinetic' attenuation of LF and HF waves	89
5.3 Very-low-frequency (VLF) and extremely-low-frequency (ELF) waves ($0 \leq \omega \ll \omega_H$)	93
5.4 Electron-acoustic waves	96
5.5 Ion-acoustic waves	98
5.6 Magnetoacoustic waves	101
5.7 Electron and ion cyclotron waves	102
6 Growth rates for the different oscillation branches	106
6.1 Generation of high-frequency (HF) waves ($\omega \gg \Omega_0$) in an isotropic plasma	107
6.1.1 Beam instability	107
6.1.2 'Anisotropic' instability	110
6.2 Excitation of HF and LF waves ($\omega \gg \omega_L$) in a magnetoplasma	110
6.2.1 Beam instability of longitudinal waves	111
6.2.2 Beam instability of transverse electromagnetic waves	115
6.2.3 Cyclotron instability for an anisotropic distribution of electron velocities	116
6.3 Excitation of the very-low-frequency (VLF) and extremely-low- frequency (ELF) oscillation branches ($0 < \omega \ll \omega_H$)	118
6.3.1 Beam instability of ion-acoustic waves ($\omega \ll \omega_0$) in an isotropic plasma	118
6.3.2 Instability of ion-acoustic waves caused by motion of the electrons relative to the ions in an isotropic plasma	119
6.3.3 Beam instability of longitudinal waves in a magnetoplasma	120
6.3.4 Beam instability of transverse electromagnetic waves in a magnetoplasma	123
6.3.5 Cyclotron instability for an anisotropic distribution of ion velocities	126
6.4 Some remarks about growth rates	127
7 Nonlinear effects in a plasma	130
7.1 General remarks	130
7.2 Nonlinear phenomena of the 'heating' type in a collisional plasma	136
7.2.1 Electron temperature and collision frequency	138
7.2.2 Large-scale changes in electron density	153
7.2.3 Cloud-like inhomogeneous structure of the perturbed plasma region. Field-aligned structure	160
7.2.4 Self-action and focusing of waves and other effects of changes in their field structure	184

7.3 Parametric nonlinear phenomena	192
7.3.1 Nonlinear spectra of the resonance branches of longitudinal waves	194
7.3.2 Parametric excitation of longitudinal waves	198
7.3.3 Parametric excitation of transverse waves	202
7.4 Nonlinear waves in a plasma. Changes in plasma properties in a nonuniform RF field	204
7.4.1 Nonlinear wave processes	207
7.4.2 Pressure on the electrons in a nonuniform RF electric field	213
 8 Group velocity, trajectories, and trapping of electromagnetic waves in a magnetoplasma	 216
8.1 Group velocity u in a homogeneous magnetoplasma	218
8.1.1 Angle α between the group-velocity vector u and the magnetic field H_0	221
8.1.2 Langmuir, ion-acoustic, and magnetoacoustic waves	236
8.1.3 Magnetoacoustic transverse waves in a nonisothermal plasma	237
8.2 Trajectories of electromagnetic waves in a smoothly varying magnetoplasma	238
8.2.1 Trajectories guided by the magnetic field H_0	239
8.2.2 Unguided ray trajectories ($\omega < \omega_L$)	241
8.3 Trapping of electromagnetic waves by the magnetic field H_0	243
8.3.1 Turning of the Poynting vector of plane waves on entering a plane-stratified inhomogeneous medium	247
8.3.2 Trapping of plane electromagnetic waves in a plane-stratified layer of magnetoplasma	251
8.3.3 Distribution of the field of electromagnetic waves emitted by a point source in directions close to H_0	260
<i>Appendix to Chapter 8</i>	269
<i>References</i>	280
<i>Author index</i>	292
<i>Subject index</i>	298