CONTENTS

| FOREWORD | v |
|---|------|
| PREFACE | vii |
| INTRODUCTION | xiii |
| 1. BASIC EQUATIONS AND BOUNDARY CONDITIONS OF | 1 |
| MAGNEIUGASDINAMIUS | 1 |
| 1. Differential Equations of Magnetogasdynamics | 1 |
| 2. Basic Definitions of the Kinetic Theory | 5 |
| 3. Unm's Law | 9 |
| 5. Limiting Conditions in Magnetogradynamics | 10 |
| 6. The Bernoulli Equation | 22 |
| 2 PROPERTIES OF IONIZED CAS | |
| | 20 |
| 1. Estimating the Coefficients of Viscosity, Thermal Conductivity and Electrical Conductivity for Monatomic Gases | 25 |
| 2. Estimating the Transfer Coefficients for Multiatomic Gases | 31 |
| 3. Determination of the Degree of Ionization of Equilibrium Plasma | 35 |
| 3. BASIC SIMILARITY CRITERIA | 41 |
| 1. Derivation of Independent Similarity Criteria | 41 |
| 2. The Physical Meaning of Similarity Criteria in Magnetogasdynamics | 46 |
| 4. ONE DIMENSIONAL STEADY-STATE PLASMA FLOWS IN CROSSED | 40 |
| ELECTRIC AND MAGNETIC FIELDS | 49 |
| 1. Qualitative Consideration of One-Dimensional Steady-State Plasma Flows | 49 |
| 2. Integration of Equations of One-Dimensional Isothermal Motion | |
| when the Velocity is a Power Function of the Cross-Sectional Area | 54 |
| 3. Solution of Equations of One-Dimensional Plasma Flow in a Constant Cross-Section Channel with Intersecting E and B Fields | 58 |
| 4. Integration of Equations of One-Dimensional Plasma Flow with Low | |
| Magnetic Reynolds Numbers | 61 |
| 5. Experimental Investigation of Plasma Motion in a Magnetic Field | 65 |
| | |

ix

| x | Contents |
|---|------------------------|
| 5. PROPAGATION OF DISTURBANCES IN PLASMA | 71 |
| Determination of the Rate of Propagation of Small Disturbances Specific Features of the Propagation of Small Disturbances in | 71 |
| 3. Experimental Investigation of the Propagation of Alfvén Waves | 78 84 |
| 6. MOTION OF IONIZED GAS IN THE ABSENCE OF DISSIPATIVE PROCESSES | 87 |
| Characteristics of Equations of Planar Steady-State Flows Characteristics in the Hodograph Plane Steady-State Flow Around a Nonconducting Wedge Flow Around Thin Bodies | 87 95 106 114 |
| 7. SHOCK WAVES IN PLASMA | 127 |
| Relationships at the Surfaces of Strong Shock Discontinuities Normal Shock Oblique Shock Polar Shock Diagrams for Flows with Parallel Field and Velocity | 127 129 134 |
| Vectors 5. Stability of Shock Waves | 140 144 |
| 8. ELECTRODE-ADJACENT LAYERS | 147 |
| Qualitative Description of Processes Occurring During the Flow of Current Through the Interface Between Hot Plasma and Cold Electrode Example of Theoretical Calculation of the Electric Field Profile and of the Concentration of Charged Particles in the Electrode- | 147 |
| Adjacent Layer 3. The Electrode-Adjacent Layer in Free Molecular Flow Around a Langmuir Probe 4. The Electrode Adjacent Layer in a Continuum Flow Around a Langmuir Probe | 149 154 |
| 4. The Electrode-Adjacent Layer in a Continuum Flow Around a Langmuir Probe | 160 |
| 5. Electrode-Adjacent Layer at Hot Electrodes in a Magnetic Field 6. Experimental Heat Transfer and Change of Potential Data for | 162 |
| Electrode-Adjacent Layers | 169 |
| 9. THE BOUNDARY LAYER IN PLASMA | 175 |
| 1. General Characteristics of the Boundary Layer in Magnetogas- dynamics | 175 |
| 2. Laminar Boundary Layer at a Flat Plate with the Magnetic Field Perpendicular to the Wall | 177 |
| 3. Laminar Boundary Layer at a Flat Plate with the Magnetic Field at an Angle to the Wall. The External Flow is Nonionized | 183 |
| Parallel to the Wall | 186 |
| Laminar Boundary Layer at a Wedge Laminar Boundary Layer in the Stagnation Point of a Blunt Body Planar and Axially Symmetric Flow of Plasma | 193 in 198 |
| 7. Magnetic Boundary Layer 8. Laminar Boundary Layer at the Electrodec of a Chennel with | 201 |
| Crossed Fields. An Inert Gas with Admixtures of Easily Ionized Substances | 202 |

| Contents | xi |
|---|------------|
| 9. Laminar Boundary Layer at Electrodes of a Channel with Crossed Fields. Completely Ionized Gas 10. Boundary Layer at Electrodes with a Break-Off in the Electron Temperature | 209 222 |
| 10. TWO-DIMENSIONAL MOTION OF PLASMA IN CHANNELS | 225 |
| 1. Plasma Flow in a Rectangular Channel | 225 |
| Plasma Flow in a Cylindrical Pipe with Nonconducting Walls in the Presence of an External Magnetic Field Perpendicular to the Pipe Axis Effect of the Electrical Conductivity of the Walls on the Character of Pileway Flow in Character | 235 |
| 4. Effect of the Hall Parameter on the Flow of Plasma Between | 240 |
| Parallel Walls in an Infinitely Wide Channel 5. Effect of the Hall Parameter on Plasma Flow in a Channel with | 244 |
| Sectionalized Electrodes | 250 257 |
| 7. Heat Transfer Between Flowing Plasma and Walls in an Infinitely | 257 |
| | 200 |
| 1. Distrady-State PLASMA FLOW | 273 |
| Transverse Magnetic Field | 273 |
| 2. General Form of Characteristics for One-Dimensional Unsteady- State Plasma Flow in a Transverse Magnetic Field | 275 |
| 3. Characteristics of Equations for One-Dimensional Flow with the Magnetic Field Inclined at an Arbitrary Angle | 278 |
| 4. Unsteady-State Plasma Flows in Channels | 281 |
| 5. The Rayleign Problem in Magnetogasaynamics | 288 |
| 12. HYDRODYNAMIC INSTABILITY OF PLASMA | 299 |
| Laminar and Turbulent Flow of Plasma Theoretical Investigations of the Stability of Laminar Plasma | 299 |
| Flow | 302 |
| 13. EQUATIONS OF TWO-TEMPERATURE MAGNETOGASDYNAMICS | 309 |
| 1. Transfer Equations for Partially Ionized Two-Temperature | 309 |
| 2. Solution of the Boltzmann Equations 3. Working Formulas for Calculating Friction, Heat Fluxes. | 312 |
| Current Density and Diffusion Rates | 319 |
| 4. Particular Cases of Fully Ionized Plasma and Plasma Without a Magnetic Field | 327 |
| 14. PRACTICAL APPLICATIONS OF MAGNETOGASDYNAMICS | 333 |
| 1. Plasma Jet Engines | 333 |
| 2. Magnetogasdynamic Electric Power Generators 3. Magnetogasdynamic Wind Tunnels | 345 349 |
| REFERENCES | 353 |
| INDEX | 929 |
| INDLA | 909 |