## CONTENTS

CHAPTER	1	Some Elements of Stellar Dynamics
	1.1	Introduction. The Stellar Distribution Function1
	1.2	Stellar Encounters and the Relaxation Time3
	1.3	The Fundamental Equation of Stellar Dynamics8
	1.4	Steps towards a Solution of the Fundamental Equation 13
	1.5	The Equations of Hydrodynamics17
	1.6	Lagrange and Eulerian Representation23
	1.7	The Hydrodynamic Equations in Cylindrical Coordinate 25
CHAPTER	2	The Density Distribution Perpendicular to the Galactic Plane
	2.1	The Force Law $K_z$ 31
	2.2	Gas Density Distribution in z-Direction32
	2.3	Determination of $K_{_{\mathbf{Z}}}$ by Observation
CHAPTER	3	The Stability of Solutions42
	3.1	The Linearized Perturbation Equations and the Problem of the Modes42
	3.2	The Jeans Criterion for Gravitational Instability46
	3.3	Gravitational Instability of Inhomogeneous Systems49
CHAPTER	4	The Dynamics of a Rotating Disk of Non-Interacting Particles
	4.1	Small Perturbations in a Circular Orbit52
	4.2	The Stability of Circular Orbits55
	4.3	Relation of the Epicyclic Frequency and the Oort Constants A and B
	4.4	Gravitational Instability in a Rotating Disk60
CHAPTER	5	The Theory of Spiral Structure of Galaxies64
	5.1	Some Observational Facts64
	5.2	Basic Dynamical Models of the Galaxy68
	5.3	The Determination of the Mass Distribution in a Galactic Model73
	5.4	Spirals, how to describe them and how to make them last
	5.5	The Basic Equations of the Lin-Theory85
	5.6	Asymptotic Theory of Tightly Wound Spiral Waves88
	5.7	The Response to a Spiral Potential Disturbance90
	5.8	The Velocity Field of Spiral Density Waves93
	5.9	Asymptotic Solution of Poisson's Equation95
	5.10	The Dispersion Equation99

	5.11	Computation of a Spiral Pattern102
CHAPTER	6	Gas Dynamical Effects on Density Waves106
	6.1	Wave Propagation in a Gas106
	6.2	Normal Shock Relations110
	6.3	The Equation of State for the Interstellar Gas113
	6.4	Density Wave Induced Shock Fronts121
	6.5	The Stationary Two Armed Spiral Shock Pattern124
	6.6	The Effect of Shock Fronts on a Multiphase Interstellar Medium129
	6.7	Can Stationary Spiral Shocks exist?132
CHAPTER	7	Observable Consequences of the Density Wave Theory .135
	7.1	Spiral Galaxies and the Density Wave Theory135
	7.2	The Gravitational Potential Field of a Spiral Arm $141$
	7.3	The Vertex Deviation144
	7.4	The Galactic Rotation Curve146
	7.5	The Local Velocity Field of a Density Wave152
	7.6	Density Waves, Galactic Shocks and 21 cm Line Emission
CHAPTER	8	Evolution and Origin of Density Waves163
	8.1	The Group Velocity of a Wave Packet163
	8.2	The Evolution of Spiral Waves164
	8.3	Resonances and Non-Linear Theory167
	8.4	Generation of Spiral Waves171
	8.5	Numerical Experiments on Spiral Structure173
	8.6	Tidal Interactions of Galaxies177
	8.7	Concluding remarks179
		Subject Index182