Contents

1. Introduction 1

2. The Equation of State and the Structure of Cosmic Objects 3
2.1 Basic Structure Equations and Ideal Equations of State 4
2.2 Non-ideal Equations of State 7
2.3 Stellar Energy Sources 14
2.4 Energy Transport 16

3. Nuclear Equations of State 21
3.1 General Remarks 21
3.2 Green's Function and Many-Body Theory 29
3.2.1 Time-Dependent Perturbation Theory 29
3.2.2 Perturbation Theory and Feynman Diagrams 33
3.2.3 Single-Particle Green's Function 37
3.3 Nucleon–Nucleon Interaction 43
3.3.1 The One-Boson-Exchange Model 45
3.3.2 NN Scattering 48
3.3.3 Medium-Range Attraction 52
3.4 Hole-Line Expansion and Other Approaches 55
3.4.1 Brueckner–Hartree–Fock 55
3.4.2 Beyond BHF 61
3.5 Relativistic Effects 66
3.5.1 Walecka Model for Nuclear Matter 66
3.5.2 Dirac–Brueckner–Hartree–Fock 69
3.6 Subnucleonic Degrees of Freedom 74
3.6.1 Excitations of the Nucleons 74
3.6.2 Pion Condensation 78
3.6.3 Effective Quark Models 84

4. Neutron Stars: Spherically Symmetric and Rotating Models 93
4.1 Spherically Symmetric Neutron Stars 93
4.1.1 Relativistic Structure Equations 95

4.1.2 Solution Method and Results 98
4.1.3 Stability and Maximum Mass 99
4.2 Rapidly Rotating Neutron Stars 101
4.2.1 Basic Formulation 103
4.2.2 Numerical Solution Method 110
4.2.3 Results 113

5. Asteroseismology 121
5.1 Oscillations of Spheres 121
5.2 Free Oscillations of the Earth 136
5.3 Helioseismology 142
5.4 Asteroseismology of White Dwarfs 154
5.5 Oscillations of Neutron Stars 162

Reprint of Friedrich Hund's Review Article 175

English Translation of Friedrich Hund's Review Article 217

References 259

Subject Index 271