Contents

CHAP.	*Sec.*		*Page*
I		INTRODUCTION	1
	1.1	Classical, Quantum and Relativity Mechanics.	
	1.2	The Nature of Scientific Law.	
	1.3	Some Preliminary Remarks.	
II		THE TENSOR CALCULUS AND RIEMANNIAN GEOMETRY	9
	2.1	Manifold of Points. Tensors.	
	2.2	Riemannian Space.	
	2.3	Geodesics.	
	2.4	Covariant Differentiation.	
	2.5	The Riemann-Christoffel and Ricci Tensors.	
	2.6	Local Cartesian and Riemannian Coordinates.	
	2.7	The Bianchi Identity and the Einstein Tensor.	
	2.8	Tensor Calculus in Relativity Theory.	
III		NEWTONIAN MECHANICS AND SPECIAL RELATIVITY	38
	3.1	Newtonian Mechanics of a Particle.	
	3.2	Newtonian Mechanics of Extended Bodies.	
	3.3	Newtonian Gravitational Theory.	
	3.4	Special Relativity.	
	3.5	The Velocity of Light.	
	3.6	Minkowski Space-time.	
	3.7	The Geodesics and Null-geodesics of the Minkowski Space-time.	
	3.8	Special Relativity Mechanics of Extended Bodies.	
IV		THE PRINCIPLES OF GENERAL RELATIVITY . .	59
	4.1	Riemannian Space-time and Einstein's Equations.	
	4.2	Determination of the Constant $\varkappa$.	
	4.3	The Geodesic Principle.	
	4.4	Orthogonal Space-times and Einstein's Equations.	
	4.5	Gravitation and the Curvature of Space-time.	
	4.6	Accelerated Coordinate-systems.	
V		THE SCHWARZSCHILD SPACE-TIME . . .	80
	5.1	Metric of the Schwarzschild Space-time.	
	5.2	The Ordinary Geodesics of the Schwarzschild Space-time.	
	5.3	Null-geodesics of the Schwarzschild Space-time.	
	5.4	Gravitational and Doppler Displacements of Spectral Lines.	

CHAP. Sec. Page

VI APPROXIMATIONS TO EINSTEIN'S EQUATIONS AND NEWTONIAN GAS-DYNAMICS 99

6.1 First Approximation to a General Orthogonal Space-time.
6.2 Newtonian Gas-dynamics.
6.3 The Geodesic Principle and Newtonian Theory.
6.4 Second Approximations. Gas-dynamics with Gravitation.
6.5 The Cosmical Constant as a Force Parameter.
6.6 Conclusions.

VII SPECIAL CASES IN NEWTONIAN GAS-DYNAMICS . 120

7.1 One-dimensional Motion.
7.2 Spherical Symmetry and Linear-waves.
7.3 Linear-wave Expansion of a Finite Sphere of Gas.
7.4 Linear-waves in a Uniform Gas.

VIII THEORY OF UNIFORM MODEL UNIVERSES . . 135

8.1 Sketch of the Observational Data.
8.2 Uniform Model Universes.
8.3 Some Geometrical Properties of Uniform Models.
8.4 The Red-shift.
8.5 Distance and the Velocity of Recession.
8.6 Apparent and Absolute Magnitudes. Colour-index.
8.7 The Number of Light-sources.
8.8 Newtonian Cosmology.

IX MODEL UNIVERSES AND THE SYSTEM OF GALAXIES 161

9.1 Time of Light-travel, Coordinate Position and Luminosity-distance.
9.2 Red-shift and Apparent Magnitude.
9.3 Numbers of Galaxies and Apparent Magnitudes.
9.4 Angular Diameter and Red-shift.
9.5 The Density and Pressure and the Cosmical Constant.
9.6 Stebbins-Whitford Two-colour-indices. Baum's Observations.
9.7 Particular Model Universes and the Age of the Universe.
9.8 Non-uniform Models.

REFERENCES AND NOTES 190

INDEX 195