

Course Notes TOC Contents

A Short Course in General Relativity

Chapter 1 Vector and Tensor Fields

- 1.0 Introduction
- 1.1 Euclidean Coordinate Systems (3-Space)
- 1.2 Index Notation
- 1.3 Tangents and Gradients
- 1.4 Coordinate Transformations in Euclidean 3-Space
- 1.5 Tensors in Euclidean 3-Space
- 1.6 Surfaces in Euclidean 3-space
- 1.7 Manifolds
- 1.8 Tensor Fields on Manifolds
- 1.9 Metric Properties
- 1.10 What and where are the bases?

Appendix C Tensors and Manifolds

- C.2 Dual Spaces
- C.3 Tensors

Chapter 2 (part 1) Geodesics and Differentiation

- 2.0 Introduction
- 2.1 Geodesics
 - Euclidean 3-Space**
 - N -Dimensional Riemannian and Pseudo Riemannian Spaces**
- 2.2 Parallel Vectors Along a Curve
 - Euclidean Space**
 - N -Dimensional Riemannian and Pseudo Riemannian Spaces**
 - Geodesic and Parallel Transport 1st Order Coordinate Independence in Manifolds**
- 2.3 Absolute and covariant differentiation
- 2.4 Geodesic coordinates

Appendix A Spacetime of Special Relativity

- A.0 Introduction
- A.1 Lorentz transformations
- A.2 Relativistic addition of velocities
- A.3 Simultaneity
- A.4 Time dilation and length contraction
- A.5 Spacetime diagrams
- A.6 Some standard 4-vectors
- A.7 Doppler effect
- A.8 Electromagnetism

Chapter 2 (part 2) Spacetime and Gravitation

- 2.5 The spacetime of general relativity
- 2.6 Newtonian gravitation and fluid dynamics
- 2.7 Gravitational potential and the geodesic
- 2.8 Newton's law of universal gravitation
- 2.9 A rotating reference system

Chapter 3 Field Equations and Curvature

- 3.0 Introduction
- 3.1 The stress tensor and fluid motion
- 3.2 The curvature tensor and related tensors
- 3.3 Curvature and parallel transport
- 3.4 Geodesic Deviation
- 3.5 Einstein's Field Equations
- 3.6 Einstein's Equation compared with Poisson's equation
- 3.7 The Schwarzschild Solution

Chapter 4 Physics in the vicinity of a massive object

- 4.0 Introduction
- 4.1 Length and time
- 4.8 Black Holes