



Approximate course outline

Part I. Special Relativity

- **Introduction: From relativistic particles to compact stars**
- **Vectors, One-forms, metric**
- **Scalars, Vectors, Tensors**
- **Principles of Special Relativity**
 - Inertial frames, Lorentz covariance
 - Lorentz transformation
 - Four vectors
 - Space-time diagrams
 - Time dilation, length contraction, twin paradox
 - Relativity of simultaneity
 - Addition of velocities
 - Acceleration in special relativity
- **Special Relativistic Mechanics**
 - Energy-momentum relation
 - Relativistic Doppler shift
 - Relativistic variational principle
- **Applications**
 - Maxwell equations
 - Relativistic quantum mechanics
 - Relativistic field theory

Part II. General Relativity

- **Acceleration, Curved Space-Time, Gravity**
- **General Covariance and Tensor equations**
- **Energy-Momentum Tensor**
- **Covariant Differentiation and Parallel Transport**
- **Derivation of Riemann Curvature Tensor**
- **Derivation of Einstein's Field Equation**
- **Relativistic Stars**
 - Neutron stars
 - Rotation in General Relativity
 - (Rotating) Black holes
- **Classical Tests of General Relativity**
- **Cosmological Models and the Universe**