PEP 552 Theory of Relativity

Week 1	**Special Relativity Basics** - Relativity as a coordinate symmetry - Coordinate symmetries - Postulates of special relativity - Lorenz transformations
Week 2	**Geometric Formulation of Special Relativity** - Minkowski spacetime - Four vectors and particle dynamics
Week 3	**Equivalence Principle** - Newton's gravity - Strong equivalence principle - Paradoxes
Week 4	**Metric Description of Curved Space** - Metric tensor - Curvature
Week 5	**Geometric Theory of Gravity** - Curved spacetime and gravitational field - Geodesic equation as equation of motion - Tidal forces and curvature of spacetime
Week 6	**Schwarzschild geometry** - Spherically symmetric metric tensor - Tests of general relativity
Week 7	**Tensors in special relativity** - Covariant and contravariant components - Covariant formulation of electromagnetism - Energy-momentum tensor
Week 8	**Tensors in general relativity** - Derivatives in curved space - Christoffel symbols - Parallel transport - Curvature tensor
Week 10	**Linearized theory of metric field** - Gauge transformation - Plane waves and polarization tensor - Emission and detection of gravitational waves

Week 11	**Black holes** - Non-rotating black holes - No-hair theorem - Kerr black holes - Black hole thermodynamics
Week 12	**Homogenous and isotropic universe** - Cosmological principle - Robertson-Walker spacetime
Week 13	**Expanding universe** - Friedmann equations - Big-bang cosmology - Cosmic microwave background
Week 14	**Inflation and accelerating universe** - Inflationary epoch - Cosmological constant revisited - Dark energy

Textbook:

Ta-Pei Cheng, *Relativity, Gravitation and Cosmology: A Basic Introduction*, Oxford University Press, 2010.