

Theoretical Physics

Syllabus

General relativity:

- Differential geometry: metric, vector, tensor, differential forms, manifold, connections, curvature, geodesic, tetrads, Lie derivatives, isometries and Killing vectors.
- Gravitation: the principle of equivalence, Einstein's equation, Hilbert-Einstein action.
- Exact solutions: Minkowski, de Sitter, anti-de Sitter spacetimes, and black hole solutions.
- Causal structure.

Quantum field theory:

- Classical field theory: Lagrangian and Hamiltonian formalism, Noether's theorem.
- Quantization: canonical quantization and path integrals.
- Fermions: representations of Poincare group, Dirac equation.
- S-matrix: LSZ reduction, Feymann propagator, Feymann rules, normal ordering, Wick's theorem, the optical theorem, locality.
- Renormalization: regularization and cutoff, counter terms, renormalization group.

Written examination

Reference:

- [1] Sean Carroll: Spacetime and Geometry: An Introduction to General Relativity
- [2] Robert M. Wald: General relativity
- [3] Michael E. Peskin and Daniel V.Schroeder: An Introduction To Quantum Field Theory
- [4] S. Weinberg: The quantum theory of fields, Vol 1