

# PLANNED SYLLABUS FOR PHYSICS 406

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The topics with “\*” may not be covered depending upon the progress made in covering the more basic topics. Also, the syllabus may be updated as the course progresses.

- (1) preliminaries
  - (a) intro and dimensional analysis
  - (b) quick review of pre-relativity physics
- (2) special relativity
  - (a) derivation of Lorentz transformations
  - (b) kinematics
  - (c) tensors
- (3) equivalence principle
  - (a) freely falling frames; strong and weak equivalence
  - (b) towards a manifold
- (4) differential geometry
  - (a) tensors in differential geometry
  - (b) curvature
- (5) fluids
  - (a) perfect fluids
  - (b) fluids in curved background and thermodynamics
- (6) Einstein equations
  - (a) derivation
  - (b) properties
- (7) symmetries
  - (a) Killing vectors
  - (b) conserved quantities
- (8) Schwarzschild solution
  - (a) derivation
  - (b) applications
- (9) tests of GR
  - (a) bending of light
  - (b) mercury’s perihelion precession
  - (c) time delay \*
- (10) more about black holes
  - (a) Kruskal extension of Schwarzschild
  - (b) Kerr-Newman black hole \*
  - (c) Penrose diagram \*
- (11) gravity waves
  - (a) perturbations and derivation of gravity wave equation
  - (b) relation to electromagnetism
- (12) big bang cosmology
  - (a) FRW solution and tests
  - (b) looking forward