ADVANCED COSMOLOGY

1-The expansion of the universe
   1- Spacetime geometry.
   2- Cosmological redshift. Hubble diagram. Luminosity and angular diameter distances.
   3- Dynamics of expansion. Einstein’s equations. Friedmann equation. Radiation, matter and the cosmological constant dominated expansion.

2-Cosmological parameters and cosmic budget.
   2- The missing mass problem. Dark matter.
   3- Accelerated expansion. Dark energy.
   4- The standard model of cosmology. The Lambda CDM model.

3- Cosmic Microwave Background
   1- Equilibrium, recombination and last scattering.
   2- Dipole anisotropy.
   3- Sunyaev-Zel’dovich effect.
   4- Primary fluctuations. Intrinsic temperature fluctuations, Doppler effect, Sachs-Wolfe effect and integrated Sachs-Wolfe effect.
   5- Reionization.

4-Thermal history and nucleosynthesis

5- The very early universe
   1- Phase transitions in the early universe. Spontaneous symmetry breaking.
   2- Vacumm energy in the standard model of particle physics and the cosmological constant problem.
   3- Grand unified theories. Baryogenesis and leptogenesis. Sakharov’s conditions.
   4- Freze-out of the cold dark matter particles. Boltzmann’s equation.
   5- Dark matter candidates. WIMPS.

6- Inflation
   1- Problems of the standard cosmological problem. Flatness, horizon, curvature and monopole problems.
   2- General definition of inflation.
   5- Chaotic inflation, eternal inflation.