EARLY UNIVERSE : 24 lectures - Semester 8

1. Introduction (4 lectures)

1.1 Review of FRW model for the universe
1.2 Natural units
1.3 Distance measures in FRW
1.4 Basic observational facts
1.5 Neutrino decoupling and the radiation density
1.6 A brief history of time

2. Structure formation (5 lectures)

2.1 Overview of structure formation
2.2 Relativistic perturbation theory in the synchronous gauge
2.3 Power series solutions
2.4 Power spectra and transfer functions
2.5 Conformal Newtonian gauge
2.6 Suppression of power on small scales due to baryons and neutrinos

3. Cosmic microwave background (4 lectures)

3.1 Basic features of the angular power spectrum
3.2 Recombination and photon decoupling
3.3 Density and velocity fluctuations
3.4 Sachs-Wolfe effects

4. Inflation (5 lectures)

4.1 Horizon and Flatness puzzles
4.2 Definition of inflation and its solution of the horizon and flatness puzzles
4.3 Potential formulation and slow roll dynamics
4.4 Reheating and the transition to radiation domination
4.5 Klein-Gordon field as a simple worked example
4.6 Fluctuations generated during inflation
4.7 Model zoo : large field, small field and hybrid models

5. Phase transitions and topological defects (4 lectures)

5.1 Discrete Goldstone model and spontaneous symmetry breaking
5.2 Symmetry restoration at high temperature
5.3 Second order phase transitions in the discrete Goldstone model
5.4 Formation of domain walls
5.5 More general defect models
5.6 Domain wall and monopole problems

6. Dark energy (2 lectures)

6.1 Evidence for dark energy
6.2 Vacuum energy and timescale problems
6.3 Quintessence