Physics 311. Outline (1979 session)

1. Review of cosmography (2 lectures)
   The darkness of night sky; recession of galaxies; isotropy of galaxy distribution; the microwave background; radio source isotropy.

2. Cosmological model-making (3 lectures)
   Postulates of isotropy, homogeneity and the Cosmological Principle; kinematics and dynamics of Newtonian world-models; the cosmological constant; the Friedmann-Lemaitre Equation; analogies with General Relativity; the (Λ,k) classification of world-models.

3. Propagation of light in model Universes (2 lectures)
   Redshift-scale relationship; photometric and diameter distances; the K-correction; brightness and brightness-temperature relations; propagation of black-body spectra; Hubble relations in terms of H_o and q_o.

4. The distance scale and observational cosmology (6 lectures)
   Parallax; moving clusters; Hyades; interstellar reddening; ZAMS; cluster fitting; RR Lyrae stars; Cepheids; brightest stars; supernovae and novae at maximum light; supernovae envelope expansions; HII region sizes; luminosity classes; Tully-Fisher effect; Abell clusters; brightest galaxies; Sandage/Tammann scale vs. de Vaucouleurs scale; systematic errors; the H_o controversy; corrections for q_o from stellar evolution and galactic cannibalism, "rigid rods" in cluster cores.

5. The Age of the Universe (1 lecture)
   Model ages; astrophysical age estimates; reciprocal Hubble time and q_o.

6. Weighing galaxies (1 lecture)
   Rotation curves; binary galaxies; virial methods in galaxies and clusters; the mean density of the Universe.

7. The models near the Singularity (5 lectures)
   Relativistic active density; energetics and significance of Penzias/Wilson temperature determination; standard model of the early universe; the hadron era; lepton era; radiation era; plasma era; statistics of relativistic fermion gases; the temperature scale; Saha equation; epochs of recombination and dynamical dominance in equilibrium expansion.

8. The origin of light nuclei (2 lectures)
   Neutron-proton ratio in lepton era; deuterium and helium synthesis; observations of deuterium and helium in Universe; a "best" standard model.

9. Radiation drag and photon viscosity (2 lectures)
   Larmor's formula; Thomson scattering; Thomson drag; inhibition of gravitational collapse.

10. The fate of isothermal and adiabatic perturbations (2 lectures)
    Smearing of adiabatic perturbations by photon diffusion; fluctuation spectra at end of plasma era; Jeans mass and gravitational instability; matter temperature after recombination; Jeans mass after recombination.

11. Galaxy formation (2 lectures)
Collapse and fragmentation vs. gravitational clustering; mass spectra of galaxy clusters and characteristic mass scales; free-fall and cooling times during collapse; opacity-limited fragmentation.

12. Galaxy evolution (2 lectures)
Galactic cores; angular momentum and turbulence; spherical, elliptical, S0 and spiral galaxies; the Hubble zoo and unsolved problems.

13. Formation of the solar system (3 lectures)
Disk formation and stabilisation by star; chemical condensation in disk; Lewis model of terrestrial planet densities; Jeans length in rotating disk; gravitational instability and gravitational clustering in disk; accretion of planets on protoplanets; Titius-Bode relation; formation of planetary atmospheres; anomalies--the mass of Mars, the asteroid belt, and Earth's Moon.

14. The "Large Numbers" and the Anthropic Principle (1 lecture)