1. Radiation intensity, flux, energy density and photon occupation number. Blackbody radiation. Rayleigh-Jeans and Wien limits. The Stefan-Boltzmann law.

2. Radiative transfer equation, emission and absorption coefficients, optical depth, Kirchhoff's law.

3. Radiation from a plane slab. Optically thin and optically thick limits.

4. Radiative diffusion; Rosseland opacity.

5. Bremsstrahlung (emission and absorption).

6. Thomson scattering. The radiation transfer equation for isotropic scattering.

7. Characteristic energies/frequencies of atomic transitions; fine and hyperfine structure. Characteristic energies/frequencies of electronic, rotational and vibrational transitions in molecules.

8. Spectral lines: quasi-classical estimate for the rate of radiative transitions; line broadening mechanisms; absorption cross-section in the spectral line.

9. Origin of the 21-cm line. Estimate of the Einstein coefficient and the absorption coefficient for this line. The relation between the spin, kinetic and brightness temperatures in the line.

10. Photoionization and photorecombination.

11. HII regions. Stromgren radius. Explain in physical terms why direct recombination into the basic state should be excluded. Scattering in resonance line: role of the frequency redistribution.

12. Basic properties of atomic nuclei. Weiszacker formula. Principles of stellar nucleosynthesis (qualitatively).

13. Rate of p-p reaction.

14. Equations of stellar structure. Dynamical and thermal time scale. Mass-luminosity relation. Eddington luminosity.

15. Degenerate matter. Minimal mass of the star with thermonuclear energy source

16. Degenerate matter. Mass-radius relation for white dwarfs. Chandrasekhar mass.

17. Doppler effect, relativistic beaming, transit-time effect, Lorentz invariancy of radiation power.

18. Synchrotron emission and absorption.

19. Inverse Compton scattering on relativistic electrons. Effect of energy losses on relativistic particle spectra and the radiation spectra.