

LESSONS

- 1) Introduction; the electromagnetic spectrum; multi-wavelength view of astrophysical objects; cgs system; energy equivalence ([slides](#)).
- 2) Definition of flux, brightness, luminosity, pressure, energy density (RL 1.2,1.3)
- 3) Emission and absorption coefficients; radiative transfer equation and its solutions; optical depth; mean free path (RL 1.4).
- 4) Thermal emission; black body; Kirchhoff law; Planck function (RL 1.5).
- 5) Stars as black bodies ([slides](#)); Einstein coefficients (RL 1.6).
- 6) Lasers/masers; scattering; random walk; extinction (RL 1.7).
- 7) Maxwell's equations; Poynting flux; electromagnetic waves in vacuum (RL 2.1, 2.2).
- 8) Electromagnetic potentials (RL 2.5); retarded potentials (RL 3.1).
- 9) Velocity and radiation fields (RL 3.2); Larmor's formula; dipole approximation (RL 3.3); Thomson scattering (RL 3.4).
- 10) Special relativity; Lorentz transformations (RL 4.1).
- 11) Four-momentum, covariant dynamics (RL 4.7); Emission from relativistic particles; beaming (RL 4.8).
- 12) Thermal bremsstrahlung: emission and absorption coefficients (G 2.1.1).
- 13) Thermal bremsstrahlung: spectrum and relation with black body (G 2.1.2).
- 14) Synchrotron: total power emitted by single particle (G 4.2); charact. frequency (G 4.3).
- 15) Synchrotron: spectrum; emission from a power-law distribution of particles (G 4.4); absorption and source function (G 4.5).
- 16) Compton scattering: Thomson and Klein-Nishina cross sections (G 5.2-5.4).
- 17) Inverse Compton scattering: Power emitted by a single particle (G 5.5).
- 18) Inverse Compton scattering: Spectrum emitted by a single particle and by a particle distribution (G 5.6).
- 19) Method of virtual quanta (J 15.4); Wave propagation in plasmas; plasma frequency (RL 8.1).
- 20) Wave propagation in plasmas; phase and group velocity; dispersion measure (RL 8.1).

21) Faraday rotation (RL 8.2); Rayleigh diffusion ([notes](#)); Blue sky (<http://hyperphysics.phy-astr.gsu.edu/hbase/atmos/blusky.html#c3>).

22) Relativistic bremsstrahlung ([notes](#)); Cherenkov radiation (RL 8.3); Nuclear reactions: threshold, pion production; hadronic gamma-rays ([notes](#)).

23) Atomic structure: configurations, terms; fine and hyperfine structure; 21cm line ([notes](#)).

24) Optical and X-ray lines; Molecular lines; Line width, Doppler broadening ([notes](#)); Red/blue shift; Allowed/forbidden transitions; Cosmic backgrounds ([slides](#)).