AT622 Review for Final

Chapter 10:

- Importance of calculation of broadband flux transmittances in calculating profiles of flux & heating rates.
- Net flux and definition of atmospheric heating rate
- Factors that influence atmospheric heating rates in SW & LW (petty eqn 10.65)
- Interpretation of net flux & heating rate profiles (Petty pp310-319)

Chapter 11:

- RTE equation with scattering: terms in it & what they mean
- When does scattering matter? Visible vs. IR, types of particles vs. gases, etc.
- Definition of a scattering phase function and the associated asymmetry parameter g, and how to calculate g.
- RTE eqn with single scattering & uses: intensity of skylight, reflectivity of the earth's clear atmosphere, calculation of very thin cloud reflectivity.

Chapter 12:

- Single scattering properties of particles: extinction, scattering & absorption efficiencies, single scattering albedo, and scattering phase function.
- Most important determinants of these properties: size parameter and (relative) complex index of refraction.
- Rayleigh scattering limit: what it means and results for single scattering properties (including the Rayleigh phase function for unpolarized light).
- Basic Mie theory results: Qe vs. Qs, meaning & use of imaginary part of refractive index, limiting cases for single scattering albedo & g.
- Behavior of phase function for small vs. large particles.
- How to apply to a distribution of particles.
- Cloud behaviors in visible, IR, & microwave.
- Basics of radar remote sensing of rainfall.

Chapter 13:

- Transmittance, absorption, and reflectance of light off a cloud or aerosol layer
- What is meant by "diffuse" transmittance?
- 2-stream approximation for multiple scattering results, especially very thick cloud case ("semi-infinite cloud") and nonabsorbing cloud.
- Effect of single scattering albedo on cloud transmittance & absorption. At what point for single scattering albedo do thick clouds become "nonabsorbing"?
- How to add a non-black surface below the cloud.

ALL PREVIOUS REVIEWS:

This includes, but is not limited to:

- The nature of E-M radiation: what is it, how fast does it travel, relationship to electric & magnetic fields.
- Definition of solid angle, conversion from radiance to (hemispheric) fluxes, definition & units for radiance/intensity, flux, both monochromatic and broadband.
- Planck's function – what it describes, units, how to use it to calculate thermal emission at a wavelength or integrated over all wavelengths
- Kirchoff's law relating emission & absorption. Emissivity.
- Reflection/ refraction at a smooth interface: Snell's law (determines direction), Fresnel relations (determines amount transmitted into new medium vs. reflected off interface)
- P vs. S polarization, and relationship to remote sensing terms "vertical" and "horizontal" polarization.
- Definition of surface emissivity, surface albedo.
- Qualitative knowledge of the LW emissivities and shortwave albedo for different kinds of surfaces (grassland/forest, ocean, desert, ice sheet).
- Beer's law & definition of optical depth vs. volume extinction coefficient.
- How to use either volume extinction, mass extinction, or cross section to calculate optical depths.
- Beer's law integral & differential form
- Solar radiation & calculation of local TOA solar insolation instantaneously or averaged over a day.
- Radiation balance – simple methods to calculate effective emission temperature of a planet (or anything) based on absorbed energy = emitted energy (radiative equilibrium)
- Cloud optical depth vs. LWP and effective radius
- RT eqn with emission & its many forms
- The weighting function & its peak
- Interpreting IR spectra (both upwelling & downwelling) : basic features in most spectra (where & how strongly different gases absorb in parts of the IR spectra, window regions)
- Deriving actual radiances or brightness temperatures from the RT equation with emission
- Molecular gas absorption: mechanisms (quantum energy transitions, role of dipole moments, selection rules for allowed transitions, basic shapes/structures of roto-vibrational absorption complexes, PQR branches, Doppler & pressure broadening, etc)
- Radiative equilibrium derivation of a planet's temperature profile without any convective adjustments, & role of azimuthal average, 2-stream assumption, gray gas assumptions, resulting features.
- Cloud radiative forcing! - how to derive the simple CRF equations at TOA or surface (assuming no multiple scattering in short wave, separate equations for high vs. low clouds in long wave), basic LW & SW CRF behaviors for high vs. low clouds, role of surface albedo, etc.