Review for Mid-term Exam 1:

1. The nature of electromagnetic radiation and electromagnetic spectrum.
Lecture 1, Eqs.[1.2]-[1.5]; Table 1.2,

2. Main radiometric quantities: flux (or irradiance) and intensity (or radiance).
Lecture 1, Eqs.[1.6]-[1.10]

3. Polarization
Lecture 2

4. Concepts of a blackbody. Planck function. Main radiation laws: Stefan-Boltzmann law, Wien's displacement law, and Kirchhoff's law.
Brightness temperature.
Lecture 2, Eqs.[2.10.1-2.12];[2.14-2.18], Lab 1

5. Emission from surfaces. Emissivity spectra of natural surfaces. Concept of passive remote sensing of sea ice.
Lecture 2, Eqs. [2.19-2.24], Table 2.1, Lab 1

6. Basic properties of atmospheric gases. Structure of molecules and associated dipole moment. Basic principles of molecular emission/absorption. Spectral line shapes: Lorentz profile and Doppler profile. Gas absorption coefficient and transmission function. Absorption spectra of radiatively active atmospheric gases.
Lecture 3, Eqs. [3.5-3.8], [3.10-3.13], Lab 2

7. Absorption spectra of radiatively active atmospheric gases.
Lecture 3, Lab 2

8. The Beer-Bouguer-Lambert (extinction) law.
Lecture 4, Eqs.[4.1-4.4]

9. Concept of scattering. Scattering phase function.
Lecture 4, Eqs.[4.5-4.8]

10. Molecular (Rayleigh) scattering. Rayleigh scattering phase function. Scattering cross section of air molecules and optical depth due to molecular scattering
Lecture 4, Eqs.[4.18-4.22], [4.26-4.27]

11. Basic properties of atmospheric aerosols and clouds. Spectral refractive indices. Scattering and absorption by aerosols and cloud drops: concepts of scattering and absorption efficiencies and cross sections; volume extinction, scattering and absorption coefficients; scattering phase function and single scattering albedo.
Lecture 4, Eqs.[4.46-4.54], Lab 3

12. Effective (total) optical properties of an atmospheric layer consisting of gas and particulates (aerosols and/or cloud particles).

Lecture 4, Eqs. [4.55]-[4.59]

13. Remote sensing using the direct solar radiation. Retrievals of aerosol optical depth and water vapor from ground-based remote sensing (AERONET).

Lecture 4, Eqs. [4.62]-[4.67], Lab 3

14. Diffuse (scattered) radiation as a source. Multiple scattering. Source function of multiple scattering.

Lectures 5, Eqs. [5.3]

15. Single and multiple scattering. Single scattering approximation.

Lectures 5, Eqs. [5.9] and [5.13]

16. Reflection from surfaces. Bi-directional reflectance distribution function. Specular and diffuse reflactenses. Lambertian reflection. Representative spectral surface albedo of natural surfaces.

Lecture 5, Eqs. [5.16-5.17]

17. Principles of ocean color retrievals.

Lecture 5

18. Principles of aerosol retrievals from passive remote sensing in the visible and near-IR.

Lecture 6, Lab 5