Review for Mid-term Exam 1:

1. Types of remote sensing platforms. Passive and active remote sensing. General characteristics: orbits, resolutions, and viewing geometry.

Lecture 1

2. The nature of electromagnetic radiation and electromagnetic spectrum.

Lecture 2, Eqs.[2.2]-[2.5]

3. Main radiometric quantities: flux (or irradiance) and intensity (or radiance).

Lecture 2, Eqs.[2.6]-[2.10]

4. Basics of polarization.

Lecture 3

5. Planck function. Main radiation laws: Stefan-Boltzmann law, Wien's displacement law, and Kirchhoff's law. Brightness temperature.

Lecture 3, Eqs.[3.10.1-3.13], [3.15-3.18], Lab 1

6. Emission from surfaces. Emissivity spectra of natural surfaces. Concept of passive remote sensing of sea ice.

Lecture 3, Eqs. [3.19-3.24], Lab 1

7. 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 4, Eqs. [4.5-4.8], [4.10-4.13], Lab 3

8. The Beer-Bouguer-Lambert (extinction) law.

Lecture 5, Eqs.[5.1-5.4]

9. Concept of scattering. Scattering phase function and asymmetry parameter.

Lecture 5, Eqs.[5.5-5.8]

10. Molecular (Rayleigh) scattering. Rayleigh scattering phase function. Scattering cross section of air molecules and optical depth due to molecular scattering

Lecture 5, Eqs.[5.18-5.22], [5.26-5.27]

11. Properties of atmospheric aerosols and clouds (size distribution and refractive index). Scattering and absorption by aerosols and cloud drops: scattering and absorption efficiencies and cross sections; volume extinction, scattering and absorption coefficients; scattering phase function and single scattering albedo.

Lecture 5, Eqs.[5.29-5.30], [5.32],[5.46 -4.54], Lab 4

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

Lecture 5, Eqs. [5.56]-[5.59]

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

Lecture 5, Eqs. [5.62]-[5.67], [5.68], Lab 4

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

Lecture 6, Eqs. [6.3]

15. First-order scattering approximation.

Lectures 6, Eqs. [6.9] - [6.13]

16. Reflection from surfaces. Specular and diffuse reflactenses. Lambertian reflection. Representative spectral surface albedo of natural surfaces.

Lecture 6, Eqs. [6.16-6.17]

17. Principles of remote sensing of ocean color.

Lecture 6

18. Combined atmosphere and surface reflection

Lecture 7, Eqs.[7.3]-[7.4]

19. Principles of aerosol retrievals from passive remote sensing in the solar spectrum.

Lecture 7, Lab 6