

Land Remote Sensing
Lab 1: Optical and Electromagnetic Theory
Assigned: August 30, 2017
Due: September 8, 2017

If you need more space to explain your answers, then please write on the back of the page or attach additional pages.

1. A small object is isotropically emitting Q watts of radiant power in space. A circular collector of aperture area A is located at distance D from the emitter. What diameter collector would be needed to intercept $0.10 \mu\text{W}$ of power with $D = 1000 \text{ km}$ and $Q = 1 \text{ kW}$?

2. Calculate the ratio of the spectral radiances of black bodies at 300 K and 6000 K at (i) a wavelength of $0.1 \mu\text{m}$; (ii) a wavelength of $1 \mu\text{m}$; (iii) a frequency of 1000 GHz ; and (iv) a frequency of 1 GHz . Comment on your results.

3. At what wavelength does your body's thermal emission peak? Assume you are a healthy 98.6°F, and ignore spectral variations in your emissivity.

4. Randomly polarized radiation at a wavelength of 3 cm is incident on a plane water surface at an angle of 83° to the normal. The dielectric constant of water at 3 cm is $63.1 - 32.1i$. Calculate the reflection coefficients for parallel and perpendicular polarizations. How would you describe the polarization of the reflected radiation?

5. Consider a 5 μW He-Ne laser beam at 0.6328 μm wavelength that passes through a cloud of 10 m thickness. The beam is directed at 30° from normal to the cloud. Calculate the absorption coefficient if the power transmitted through the cloud is measured to be 1.57576 μW . Repeat for a transmitted power of 0.01554 μW .

6. *Explain* why wet sand appears darker (has a lower albedo) than dry sand.

7. Familiarize yourself with some publicly available terrestrial data and the sensors that acquire them. Some sites to start with include:

- <http://science.nasa.gov/earth-science/missions/>
- <http://earth.esa.int/web/missions/esa-operational-eo-missions/>
- <http://earthexplorer.usgs.gov/>

Using these and other resources, investigate the technical specifications of Landsat-7 vs. SPOT-6, two commonly used surface remote sensing instruments. Regarding resolution (spatial, temporal, spectral, and radiometric), spectral range, and coverage, what are the advantages and disadvantages of each? Describe an application for which each satellite is clearly more appropriate than the other.