

Question Bank

1. Define remote sensing and list its main components.

Answer: Remote sensing is the science of acquiring information about an object or phenomenon without making physical contact with it. The main components of remote sensing include:

- **Source of Energy (Electromagnetic Radiation):** Natural (sunlight) or artificial (radar waves).
 - **Atmosphere:** The medium through which the energy travels to reach the Earth and the sensors.
 - **Target:** The object or surface from which the energy is reflected or emitted.
 - **Sensor:** The device used to detect the reflected or emitted energy.
 - **Data Acquisition and Processing:** Capturing and processing the data into meaningful information.
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2. Explain the importance of the electromagnetic spectrum in remote sensing.

Answer: The electromagnetic spectrum is crucial in remote sensing because it encompasses all possible wavelengths of electromagnetic radiation, from gamma rays to radio waves. Remote sensing relies on the interaction of this radiation with the Earth's surface. Different materials reflect and absorb different wavelengths uniquely, allowing sensors to detect and differentiate between various materials and surface features. Key wavelength regions important to remote sensing include visible light, infrared, and microwave regions.

3. Describe the wave theory and particle theory of electromagnetic radiation.

Answer:

- **Wave Theory:** This theory describes electromagnetic radiation as waves that travel through space at the speed of light. The wave's properties are characterized by its wavelength (distance between successive crests) and frequency (number of crests passing a point per unit time).
- **Particle Theory:** This theory posits that electromagnetic radiation consists of particles called photons, which carry energy. The energy of these photons is directly proportional to the radiation's frequency, explaining the quantum nature of light.

4. What is the Stefan-Boltzmann Law, and why is it important in remote sensing?

Answer: The Stefan-Boltzmann Law states that the total energy radiated per unit surface area of a black body is directly proportional to the fourth power of its absolute temperature (T).

Mathematically, it is expressed as: $E = \sigma T^4$ where E is the radiated energy, σ is the Stefan-Boltzmann constant, and T is the temperature in Kelvin.

This law is important in remote sensing because it helps in understanding the thermal emission of objects, which is critical in thermal infrared remote sensing.

5. What are atmospheric windows, and why are they significant in remote sensing?

Answer: Atmospheric windows are specific wavelength ranges in the electromagnetic spectrum where the Earth's atmosphere is mostly transparent, allowing electromagnetic radiation to pass through with minimal absorption or scattering. These windows are significant in remote sensing because they determine which wavelengths can be used for observing the Earth from space. Key atmospheric windows include the visible light, infrared, and microwave regions.

6. Discuss the spectral signature concept and provide examples for water, vegetation, and soil.

Answer: A spectral signature is the specific pattern of reflectance or emittance of electromagnetic radiation by an object across different wavelengths. This pattern is unique to each type of material and is used to identify and differentiate between objects or surfaces in remote sensing data.

- **Water:** Typically has low reflectance in the visible spectrum and very low reflectance in the near-infrared spectrum, resulting in a distinct spectral signature.
- **Vegetation:** Shows high reflectance in the near-infrared region and lower reflectance in the visible region, especially in the green band, due to chlorophyll absorption.
- **Soil:** Has a more uniform reflectance across the visible and near-infrared regions, but the exact spectral signature can vary depending on the soil's moisture content, organic matter, and texture.

7. What are the different types of atmospheric scattering? Explain each briefly.

Answer:

- **Rayleigh Scattering:** Occurs when the particles causing the scattering are much smaller than the wavelength of radiation. It is responsible for the blue color of the sky, as shorter (blue) wavelengths are scattered more than longer (red) wavelengths.
- **Mie Scattering:** Occurs when the particles are about the same size as the wavelength of radiation. It is common in lower parts of the atmosphere where larger particles like dust and water droplets exist.
- **Non-selective Scattering:** Occurs when the particles are much larger than the wavelength of radiation, such as in the case of large water droplets or ice crystals in

clouds. This type of scattering affects all wavelengths equally, leading to the white appearance of clouds.

8. Explain Wein's Displacement Law and its relevance to remote sensing.

Answer: Wein's Displacement Law states that the wavelength at which the emission of a black body is maximum is inversely proportional to its temperature. The law is mathematically expressed as: $\lambda_{\text{max}} = \frac{b}{T}$ where λ_{max} is the peak wavelength, T is the absolute temperature in Kelvin, and b is Wein's constant.

This law is relevant to remote sensing, particularly in thermal infrared remote sensing, as it allows for the determination of the temperature of an object based on the wavelength at which it emits radiation most strongly.

9. What are the typical spectral reflective characteristics of vegetation, soil, and water?

Answer:

- **Vegetation:** High reflectance in the near-infrared region, moderate reflectance in the green region, and low reflectance in the blue and red regions due to chlorophyll absorption.
 - **Soil:** Reflectance varies depending on moisture content, organic matter, and texture. Generally, soil has moderate and more uniform reflectance across the visible to near-infrared regions.
 - **Water:** Low reflectance across the visible and near-infrared regions, with the lowest reflectance in the near-infrared due to strong absorption by water.
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10. Why is the concept of spectral signature critical in remote sensing applications?

Answer: The concept of spectral signature is critical in remote sensing because it allows for the identification and classification of different materials and surfaces on the Earth. Each material reflects or emits electromagnetic radiation differently across various wavelengths, creating a unique spectral signature. By analyzing these signatures, remote sensing applications can differentiate between water bodies, vegetation types, soil conditions, and other surface features, leading to accurate mapping, monitoring, and analysis.