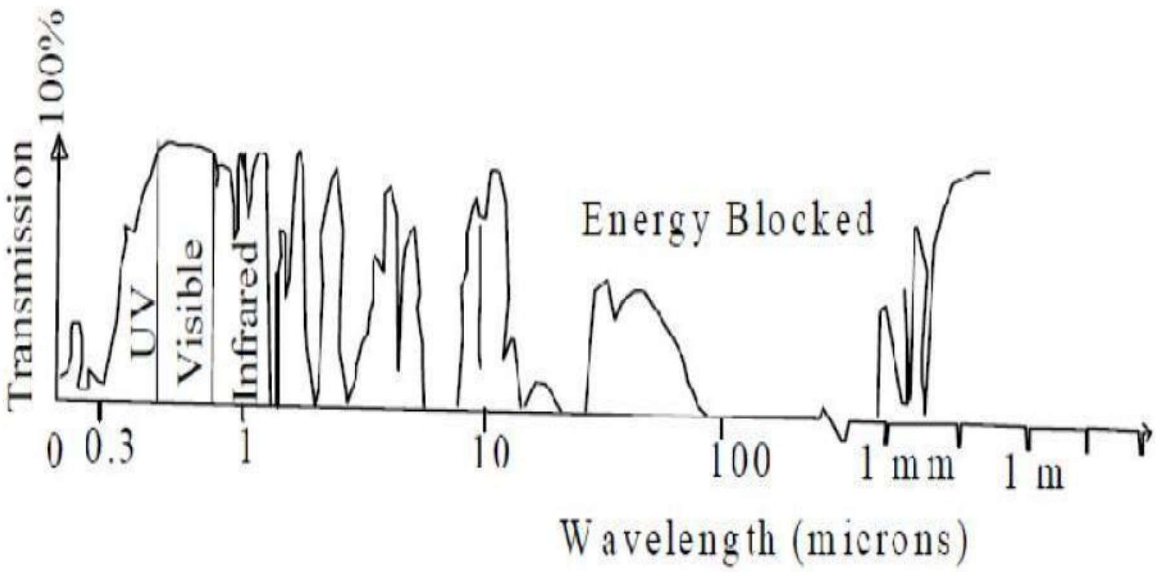
2. ATMOSPHERIC WINDOWS

- While EMR is transmitted from the sun to the surface of the earth, it passes through the atmosphere.
- Here, electromagnetic radiation is scattered and absorbed by gases and dust particles.
- Besides the major atmospheric gaseous components like molecular nitrogen and oxygen, other constituents like water vapour, methane, hydrogen, helium and nitrogen compounds play important role in modifying electromagnetic radiation.
- This affects image quality.
- Regions of the electromagnetic spectrum in which the atmosphere is transparent are called atmospheric windows.
- The atmosphere is practically transparent in the visible region of the electromagnetic spectrum and therefore, many of the satellite based remote sensing sensors are designed to collect data in this region.
- Some of the commonly used atmospheric windows are shown in thefigure.



3. SPECTRAL SIGNATURE CONCEPTS-TYPICAL SPECTRAL REFLECTANCE - CHARACTRISTICS OF WATER, VEGETATION AND SOIL:

- A basic assumption made in remote sensing is that a specific target has an individual and characteristic manner of interacting with incident radiation.
- The manner of interaction is described by the spectral response of the target.
- The spectral reflectance curves describe the spectral response of a target in a particular wavelength region of electromagnetic spectrum.
- The spectral reflectance curve depends upon certain factors, namely, orientation of the sun (solar azimuth), the height of the Sun in the sky (solar elevation angle), the direction in which the sensor is pointing relative to nadir (the look angle) and nature of the target.

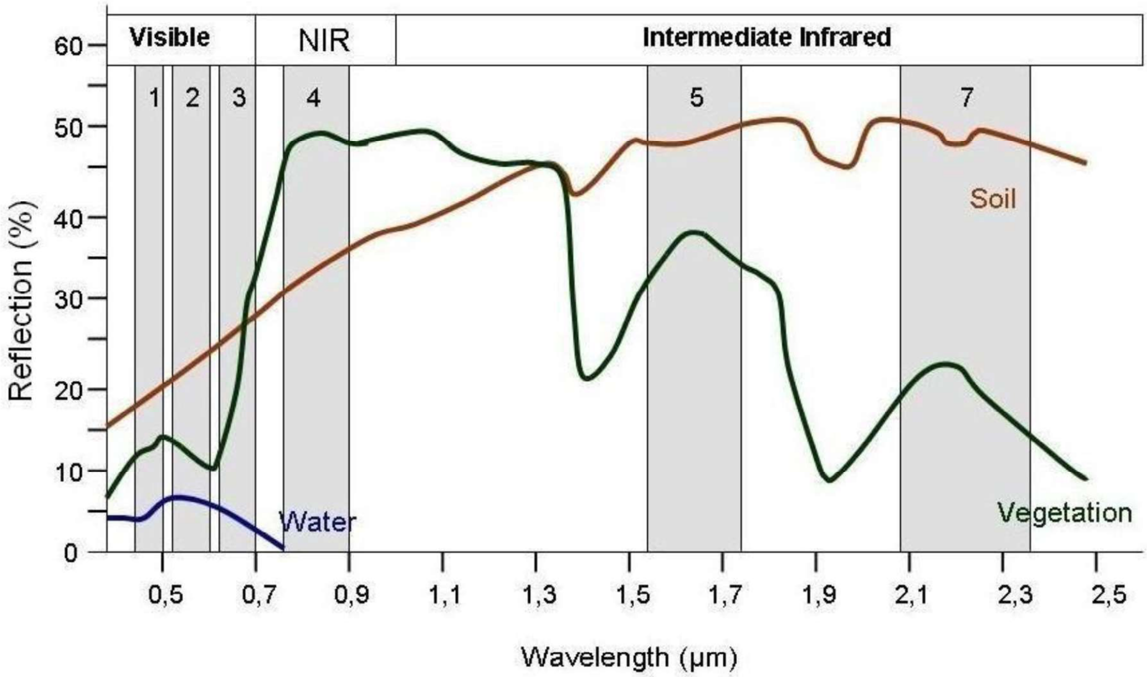


Fig 2.3 Spectral reflectance Curve

Every object on the surface of the earth has its unique spectral reflectance.

The spectral reflectance curves for vigorous vegetation manifsoil, the "Peak- and-valley" configuration.

The valleys in the visible portion of the spectrum are indicative of pigments in plant leaves.

The soil curve shows a more regular variation of reflectance.

Factors that evidently affect soil reflectanceare moisture content, soil texture, surface roughness, and presence of organic matter.

The term spectral signature can also be used for spectral reflectance curves.

Spectral signature is aset of characteristics by which a material or an object may be identified on any satellite imageor photograph within the given range of wavelengths. Sometime &, spectral signatures are used to denote the spectral response of a target.

The characteristic spectral reflectance curve Fig2.3 for water shows that from about 0.5µm, a reduction in reflectance with increasing wavelength, so that in the near infrared range, the reflectance of deep, clear water is virtually a zero (Mather, 1987). However, the spectral reflectance of water is significantly affected by the presence of dissolved and suspended.

organic and inorganic material and by the depth of the water body. Fig. 1.8 shows the spectral reflectance curves for visible and near-infrared wavelengths at the surface and at 20 m depth.

Suspended solids in water scatter the down welling radiation, the degree of scatter being proportional to the concentration and the color of the sediment. Experimental studies in the field and in the laboratory as well as experience with multispectral remote sensing have shown that the specific targets are characterized by an individual spectral response. Indeed, the successful developmentof remote sensing of environment over the past decade bears witness to its validity. In the remaining part of this section, typical and representative spectral reflectance curves for characteristic types of the surface materials are considered.

Imagine a beach on a beautiful tropical island. of electromagnetic radiation with the top layer of sand grains on the beach. When an incident ray of electromagnetic radiation strikes an air/grain interface, part ofthe ray is reflected and part of it is transmitted into the sand grain. The solid lines in the figurerepresent the incident rays, and dashed lines 1, 2, and 3 represent rays reflected from the surfacebut have never penetrated a sand grain. The latter are called specular rays by Vincent and Hunt(1968), and surface-scattered rays by Salisbury and Wald (1992); these rays result from first-surface reflection from all grains encountered.

For a given reflecting surface, all specular rays reflected in the same direction, such that the angle of reflection (the angle between the reflected rays and the normal, or perpendicular to the reflecting surface) equals the angle of incidence (the angle between the incident rays and the surface normal). The measure of how much electromagnetic radiation is reflected off a surfaceis called its reflectance, which is a number between 0 and 1.0. A measure of 1.0 means the 100% of the incident radiation is reflected off the surface, and a measure of 0 means that 0% is reflected.

ENERGY INTERACTIONS WITH EARTH SURFACE FEATURES

Energy incident on the Earth ‘s surface is absorbed, transmitted, or reflected depending on the wavelength and characteristics of the surface features (such as barren soil, vegetation, water body). Interaction of the electromagnetic radiation with the surface features is dependent on the characteristics of the incident radiation and the feature characteristics. After interaction with the surface features, energy that is reflected or re-emitted from the features is recorded atthe sensors and are analyzed to identify the target features, interpret the distance of the object,and /or its characteristics. This lecture explains the interaction of the electromagnetic energy with the Earth ‘s surface features.

Energy Interactions

Spectral Reflectance of Earth SurfaceVegetation

In general, healthy vegetation is a very good absorber of electromagnetic energy in the visible region. Chlorophyll strongly absorbs light at wavelengths around 0.45 (blue) and 0.67 µm (red) and reflects strongly in green light, therefore our eyes perceive healthy vegetation as green. Healthy plants have a high reflectance in the near-infrared between 0.7 and 1.3 µm. This is primarily due to healthy internal structure of plant leaves. As this internal structure varies amongst different plant species, the near infrared wavelengths can be used to discriminate between different plant species.

Water

In its liquid state, water has relatively low reflectance, with clear water having the greatest reflectance in the blue portion of the visible part of the spectrum. Water has high absorption and virtually no reflectance in near infrared wavelengths range and beyond. Turbid water has a higher reflectance in the visible region than clear water. This is also true for waters containing high chlorophyll concentrations.

Ice and Snow

Ice and snow generally have high reflectance across all visible wavelengths, hence their brightwhite appearance. Reflectance decreases in the near infrared portion and there is very low reflectance in the SWIR (shortwave infrared). The low reflection of ice and snow in the SWIRis related to their microscopic liquid water content. Reflectance differs for snow and ice depending on the actual composition of the material including impurities and grain size.

Soil

Bare soil generally has an increasing reflectance, with greater reflectance in near-infrared and shortwave infrared. Some of the factors affecting soil reflectance are:

- Moisture content
- Soil texture (proportion of sand, silt, and clay)
- Surface roughness
- Presence of iron oxide
- Organic matter content