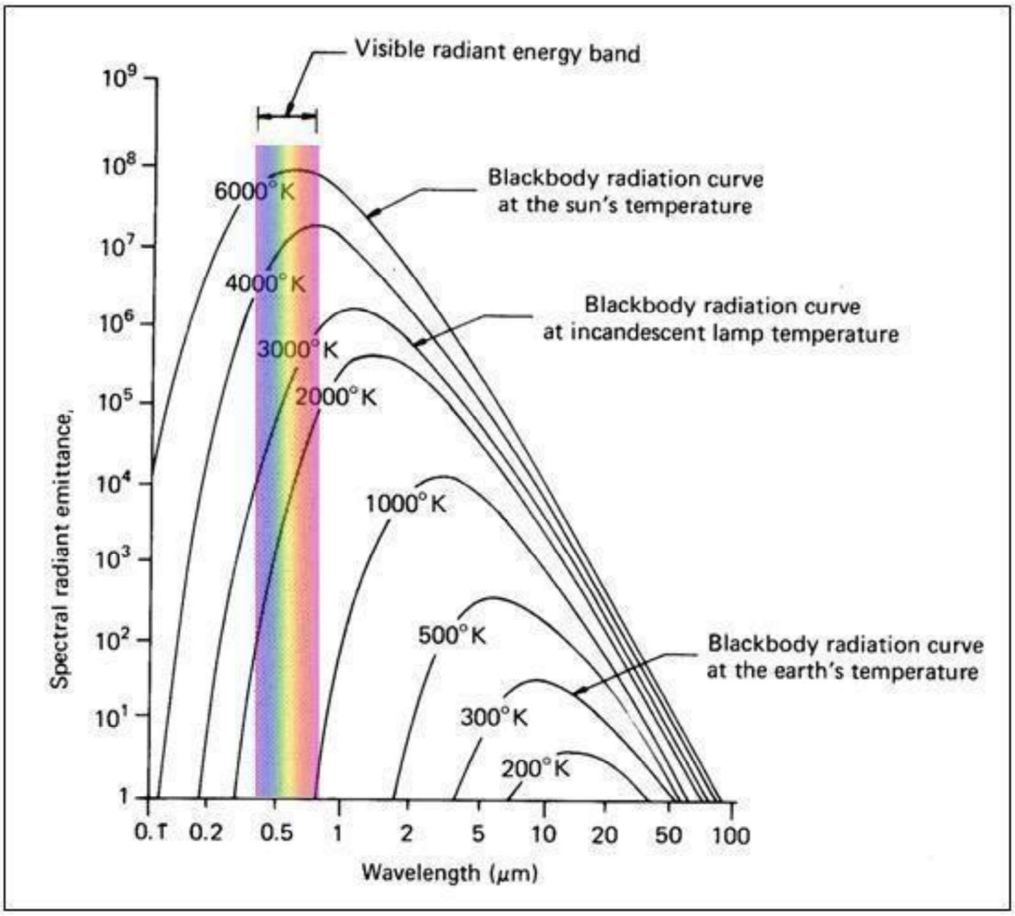

Figure5. Spectral energy distribution of blackbody at various temperatures

From Fig. 4, it can be observed that the peak of the radiant exitance varies with wavelength. Asthe temperature increases, the peak shifts towards the left. This is explained by the Wien‘s displacement law. It states that the dominant wavelength at which a black body radiates λ_m is Inversely proportional to the absolute temperature of the black body (in *K*) and is represented asgiven below.

RADIATION SOURCES

Remote sensing involves the use of various technologies to gather information about the Earth's surface and atmosphere from a distance. Radiation sources are crucial components in remote sensing, as they emit or reflect electromagnetic radiation that can be detected by sensors to gather information about the Earth's features and properties. Here are some common radiation sources used in remote sensing.

Sunlight (Solar Radiation):

The Sun is the primary natural radiation source for remote sensing. Sunlight emits a broad spectrum of electromagnetic radiation, including visible, infrared, and ultraviolet wavelengths. Sensors onboard satellites and other remote sensing platforms capture this solar radiation reflected or emitted by Earth's surface and atmosphere.

SAR (Synthetic Aperture Radar):

SAR systems emit microwave radiation towards the Earth's surface. The emitted radiation interacts with the surface, and the reflected signal is captured by the sensor. SAR can operate in various modes, such as single-pass, repeat-pass, and interferometric modes, providing valuable information about surface characteristics, topography, and changes over time.

LIDAR (Light Detection and Ranging):

Lidar systems emit laser pulses towards the Earth's surface and measure the time it takes for the laser to return after reflecting off objects. This information is used to create detailed 3D maps of the terrain, vegetation, buildings, and other features. Lidar is commonly used for forest monitoring, topographic mapping, and urban planning.

Passive Microwave Radiation:

Microwave radiation is emitted by the Earth's surface in the form of thermal radiation. Sensors can detect these microwave emissions to study soil moisture, ice cover, and ocean salinity, among other parameters. Passive microwave sensors can operate in different frequency bands to capture specific information.

Artificial sources (Active sources):

In some cases, remote sensing platforms carry their own radiation sources. These active sensors emit radiation and measure the reflected or backscattered signal. For example, some satellite altimeters emit radar signals that bounce off the ocean surface to measure sea level changes.

Infrared Emission (Thermal Infrared):

All objects with a temperature above absolute zero emit thermal infrared radiation. Sensors that detect thermal infrared radiation can capture information about surface temperature, energy balance, and thermal properties of various materials.

Hyperspectral Imaging:

Hyperspectral sensors capture electromagnetic radiation in numerous narrow and contiguous spectral bands. This allows for the identification and differentiation of various materials based on their unique spectral signatures. Hyperspectral data is valuable for applications like mineral exploration, land cover classification, and environmental monitoring.

X-Ray and Gamma Ray Sensors:

In some specialized applications, X-ray and gamma-ray sensors are used to detect radiation emitted by the Earth's surface. These sensors can provide information about soil composition, minerals, and even detect radioactive sources.

Magnetometers:

While not emitting radiation themselves, magnetometers are used to measure the Earth's magnetic field. Variations in the magnetic field can provide information about subsurface structures, mineral deposits, and geological formations.

These various radiation sources and sensors contribute to a comprehensive understanding of the Earth's surface, atmosphere, and processes. They enable scientists and researchers to study and monitor changes in the environment, natural disasters, climate patterns, and much more from a remote perspective.

KIRCHOFF'S LAW:

Kirchhoff's law of thermal radiation, often referred to as Kirchhoff's law in remote sensing, is an important principle used to understand the relationship between the emissivity and absorptivity of a material at a particular wavelength. This law is relevant in the context of thermal remote sensing, where the emitted thermal radiation from the Earth's surface is measured to extract information about surface properties.

Kirchhoff's law states that at thermal equilibrium, the emissivity (ε) of a material is equal to its absorptivity (α) at a given wavelength. In mathematical terms:

$$\varepsilon(\lambda) = \alpha(\lambda)$$

Where:

$\varepsilon(\lambda)$ is the emissivity of the material at wavelength λ.

$\alpha(\lambda)$ is the absorptivity of the material at wavelength λ.

RADIATION QUANTITIES:

In the context of remote sensing and the study of electromagnetic radiation, there are several fundamental radiation quantities that are commonly used to describe the characteristics and behavior of electromagnetic waves. These quantities help us understand the properties of radiation and how it interacts with various materials and surfaces. Here are some important radiation quantities:

Radiant flux (Power):

Radiant flux, often referred to simply as power, is the total amount of energy emitted by a radiation source per unit time. It is measured in watts (W).

Radiant intensity:

Radiant intensity is the amount of radiant flux emitted by a point source in a particular direction within a solid angle. It is measured in watts per steradian (W/sr).

Radiance:

Radiance is the radiant flux emitted or reflected by a surface per unit area, per unit solid angle, and per unit wavelength interval. It describes the intensity of radiation from a surface in a specific direction. Radiance is measured in watts per square meter per steradian per nanometer ($W/(m^2 \cdot sr \cdot nm)$).

Irradiance:

Irradiance is the radiant flux incident on a unit area of a surface. It quantifies the power received by a surface per unit area. Irradiance is measured in watts per square meter (W/m^2).

Radiosity:

Radiosity is the total radiant flux emitted by a surface per unit area and is the sum of the emitted radiance and the reflected irradiance. It is often used in radiative heat transfer calculations.

Exitance (Emittance):

Exitance, also known as emittance, is the radiant flux emitted by a surface per unit area. It is similar to irradiance, but it accounts for both emitted and reflected radiation.

Reflectance:

Reflectance is the ratio of the radiant flux reflected by a surface to the incident radiant flux upon it. It is a dimensionless quantity often expressed as a percentage.

Transmittance:

Transmittance is the ratio of the transmitted radiant flux through a medium (such as atmosphere or water) to the incident radiant flux upon the medium.

Absorptance:

Absorptance is the ratio of the absorbed radiant flux by a surface to the incident radiant flux upon it. It is complementary to reflectance and transmittance.

Emissivity:

Emissivity is the ratio of the radiant flux emitted by a surface to the radiant flux emitted by a blackbody.