Black body radiation refers to the theoretical concept of an idealized object that absorbs all incoming radiation and emits thermal radiation in a specific, predictable manner. The laws governing black body radiation heat transfer are fundamental in thermodynamics and quantum mechanics. Here are the key laws:

1. Planck's Law

Planck's Law describes the spectral distribution of radiation emitted by a black body at a given temperature. It provides a formula for the intensity of radiation emitted as a function of wavelength and temperature. The law is expressed as:

$$I(\lambda, T) = \frac{2hc^2}{\lambda^5} \cdot \frac{1}{e^{\frac{hc}{\lambda k_B T}} - 1}$$

2. Stefan-Boltzmann Law

The Stefan-Boltzmann Law gives the total power radiated by a black body across all wavelengths per unit area, proportional to the fourth power of its absolute temperature:

$$P = \sigma T^4$$

3. Wien's Displacement Law

Wien's Displacement Law relates the temperature of a black body to the wavelength at which it emits the maximum radiation. The law is expressed as:

$$\lambda_{max} = \frac{b}{T}$$

4. Kirchhoff's Law of Radiation

Kirchhoff's Law states that, for a body in thermal equilibrium, the emissivity (ε) of a body is equal to its absorptivity (α) at every wavelength. For a perfect black body, both emissivity and absorptivity are equal to 1.

$$\epsilon = \alpha$$