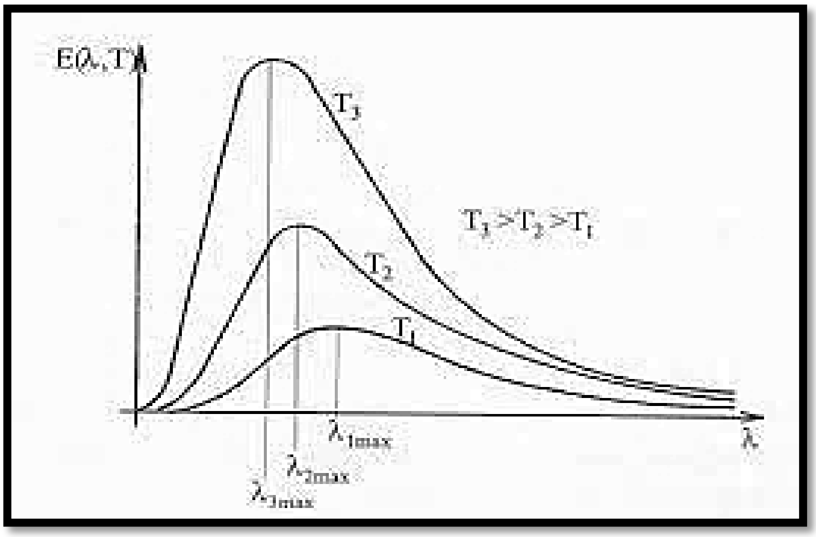
- **Blackbody Radiation**
- If we heat an object up to about **1500 degrees** we will begin to see a **dull red glow** and we say the object is **red hot**. If we heat something up to about **5000 degrees**, near the temperature of the sun's surface, it radiates well throughout the visible spectrum and we say it is **white-hot**.
- A **black body** is a body that absorbs all the EM radiation (light ...) that strikes it. To stay in thermal equilibrium, the radiation must emit at the same rate as its absorption in order for the black body to radiate well.
- Because black body is the best absorber of all wavelengths of visible light, it should also be the best emitter.
- **Blackbody Radiation** It is known that the amount of radiation energy emitted from a surface at a given wavelength depends on the **material** of the body and the **condition** of its **surface** as well as the surface **temperature**. Therefore, various materials emit different amounts of radiant energy even when they are at the same temperature. A **body** that emits the **maximum amount** of heat for its absolute temperature is called a **blackbody**.
- By definition, a black body in thermal equilibrium has an emissivity of **ε=1**. Real objects do not radiate as much heat as a perfect black body. They radiate less heat than a black body and therefore are called **gray bodies**.

- **Wien's law or Wein Displacement Law**: - It tells us as we heat an object up (piece of iron), its color changes from ***red*** to ***orange*** to ***white*** hot. According to Wien's law the product of wavelength corresponding to maximum intensity of radiation and temperature (K) of body is constant. Eq. (11).

$$\lambda_{max} = b/T \quad ....(11)$$

❖ From this law you can use this to calculate the temperature of stars. The surface temperature of the Sun is 5778 K, this temperature corresponds to a peak emission = 502 nm = about 5000 Å. **b** is a constant of proportionality, called **(*Wien's displacement constant*** = $2.89*10^6$ **nm**.K).

❖ **Wien** explained (***Wien's Displacement Law***) that the spectrum of hot body is a continuous spectrum, shows radiation with different wavelengths, and as the temperature of the body increases the energy of radiation emitted from it increased, (Therefore, as temperature increases, the glow color changes from **red** to **yellow** to **white** to **blue**).



❖ ***Stefan-Boltzmann law:*** The **total** energy **E** radiated from per unit surface area (square meter) of black surface at temperature **T** is proportional to the **fourth power** of the absolute temperature (**T^4**). Eq. (12).

❖ $$J^* = \sigma * \varepsilon * T^4 \quad \text{.....................(12)}$$

❖ Where **J^*** = power radiated (**Watt**) per unit area from black body.

e= Emissivity =1 for ideal radiator

σ = Stefan-Boltzmann constant =$5.67*10^{-8}$ **$W.m^{-2}.K^{-4}$**.

T= surface temperature of the body in **K.**

❖ The emissivity is the ratio of energy radiated by the body to the energy radiated by a black body with the same temperature.

❖ The surface of a blackbody emits thermal radiation at the rate of approximately **(448 W/m^2)** at room temperature (25 °C, 298.15 K). Real objects with emissivities less than 1.0 (e.g. copper wire) emit radiation at correspondingly lower rates (e.g. 448 x 0.03 = 13.4 **W/m^2**). **Emissivity** plays important role in heat transfer problems.