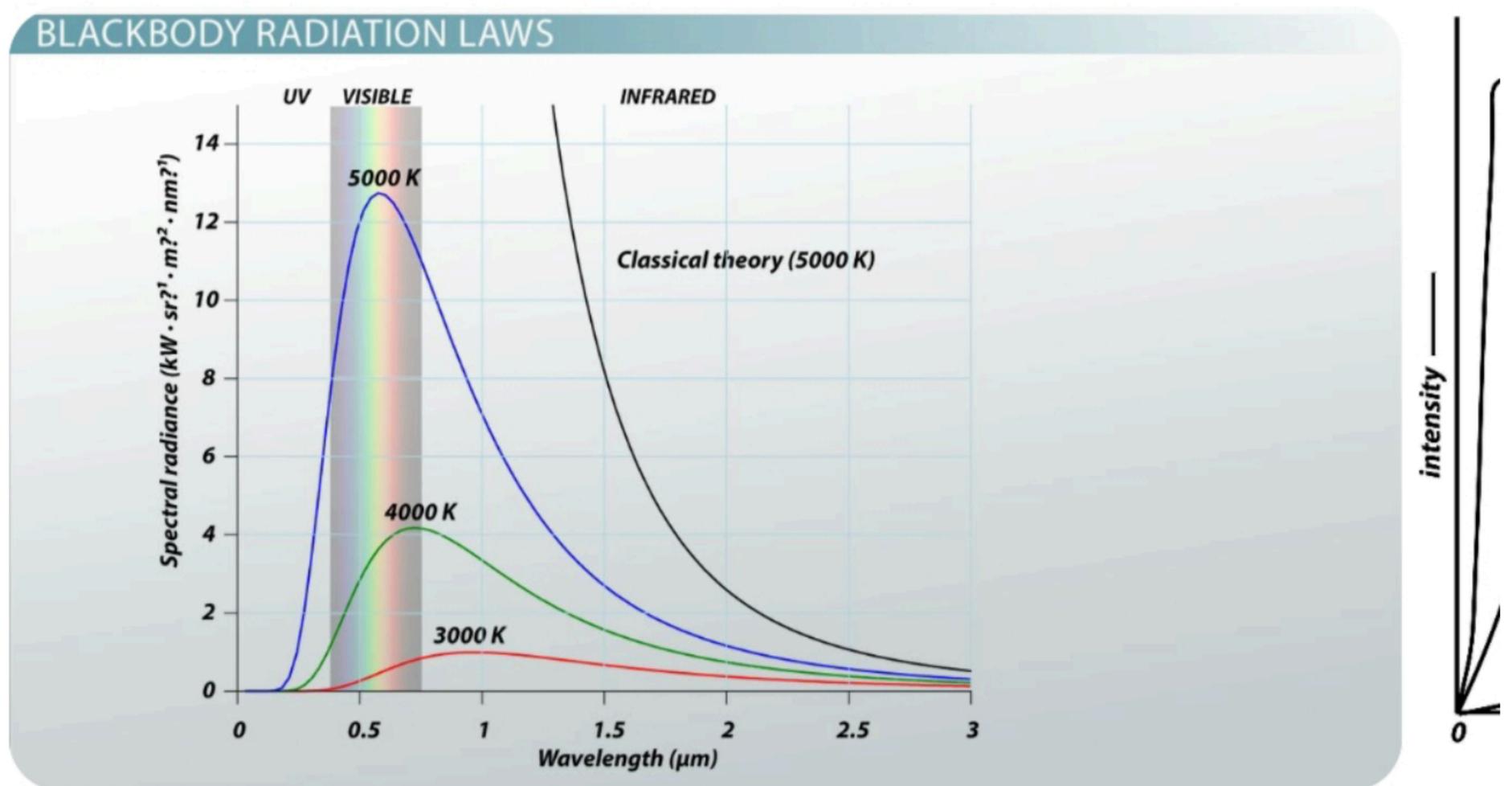# Semester–VI | Unit–2

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MJC Physics – Unit 2

Stefan–Boltzmann Law

3. Mathematical Expression

$$E \propto T^4$$

Introducing the proportionality constant,

$$E = \sigma T$$

where,

- E = radiant energy emitted per unit area per unit time (W m⊠^{-2}⊠)

- T = absolute temperature in kelvin (K)

- σ = Stefan–Boltzmann constant

$$\sigma = 5.67 \times 10^{-8} \ \mathrm{W \ m^{-2} K^{-4}}$$

4. Stefan–Boltzmann Law for Real Bodies

Real bodies do not behave as perfect blackbodies. Hence, the law is modified as:

$$E = \varepsilon \sigma T^4$$

where,

- ε = emissivity of the body
- $0 < \varepsilon \leq 1$

5. Physical Significance

- Radiant energy increases very rapidly with temperature.

- If the temperature of a body is doubled, the energy radiated becomes **16 times**.

- This explains intense radiation from very hot objects such as stars and furnaces.

6. Historical Background

The law was experimentally formulated by **Josef Stefan** in 1879.

Later, it was theoretically derived using thermodynamics by **Ludwig Boltzmann**, hence known as the **Stefan–Boltzmann law**.

7. Applications

1. Determination of surface temperature of the Sun and stars

2. Study of blackbody radiation

3. Heat transfer by radiation

4. Thermal engineering and furnace design

5. Atmospheric and climate physics

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8. Conclusion

The Stefan–Boltzmann law provides a fundamental relationship between temperature and thermal radiation. It plays a vital role in **MJC Physics Unit–2, Semester–VI** and has wide applications in theoretical and applied physics.