

Module 9: Learning objectives

- In this chapter of radiation heat transfer, many new important ideas will be introduced. The treatment and terminology is quite different from those of conduction and convection heat transfer. In order to avoid confusion and to link radiation heat transfer with other modes of heat transfer, the subject matter has been developed in a systematic fashion, and careful rereading of the material should make you more comfortable with its application.
- You should be able to answer the following questions, which have mostly to do with terminology and definitions. What is radiation, and what position does thermal radiation occupy in the electromagnetic spectrum? What are the physical origins of thermal radiation? What are meant by the term irradiation, emissive power, and radiosity? What material property characterizes the ability of a surface to emit thermal radiation? What processes and associated materials properties characterize the manner in which a surface responds to irradiation? What is an opaque surface? A semitransparent surface?
- You should recognize the difference between directional and spectral radiation properties on the one hand and hemispherical and total properties on the other. Moreover, you should be able to proceed from knowledge of the former to determination of the latter. You should also appreciate the unique role of the black body in the description of thermal radiation. In what sense is the black body ideal? Why is it an idealization, and how it may be approximated in practice? What is the Planck distribution? How is it altered by increasing surface temperature? What are the Wein-Stefan –Boltzman laws?
- Relations between emissivity and absorptivity are often extremely important in radiative exchange calculations. What is Kirchhoff's law, and what restrictive conditions are inherent in its deviation? What is a gray surface and under what conditions might the assumption of grey surface be particularly suspect? Finally what are the characteristics of solar radiation? In what region of the spectrum is this radiation concentrated, and how is it altered due to passage through the earth's atmosphere? What is the nature of its directional distribution at the earth's surface?
- In this chapter, we also focused on the analysis of radiation exchange between the surfaces of an enclosure, and in treating this exchange we introduced the view factor concept. Because knowing this geometrical quantity is essential to determining radiation exchange between any two diffuse surfaces, and you should be familiar with the means by which it may be determined. You should also be adept at performing radiations calculations for an enclosure of isothermal, opaque, diffuse, and gray surfaces of uniform radiosity and irradiation. Moreover, you should be familiar with the results that apply to simple cases such as the two surfaces enclosure or the three-surface enclosure with reradiating surface.