Radiation: Gray Surfaces
Sections 12.5 to 12.8

Reminders...

- Homework #10 due Friday
  - Help session 4:30 today in MEB 3235

- Final draft report due Friday
  - Email to report@chen3453.com in Microsoft Word format
  - Name the file “Lastname_Firstname.docx”
    - Can also be in .doc format
  - For the subject, write “Lastname Firstname - Heat Transfer Draft Report”
  - Send by 8:00 PM Friday

- Midterm #2 can be picked up in ChE office
• What is the total emissivity of an object with the spectral emissivity shown below?

![Graph showing spectral emissivity vs. wavelength (μm)]
Radiation Transfer Types

- **Emission** ($E$)
  - Associated with energy transfer due to surface temperature
- **Irradiation** ($G$)
  - Radiation incident onto a surface
  - Irradiation can have three fates:
    - Absorption by the surface
      ($\alpha = \text{absorptivity} = \text{fraction of } G \text{ absorbed}$)
    - Reflection by the surface
      ($\rho = \text{reflectivity} = \text{fraction of } G \text{ reflected}$)
    - Transmission through the material
      ($\tau = \text{transmissivity} = \text{fraction transmitted}$)

Irradiation onto a Surface

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  - **Absorption** by the surface
    ($\alpha = \text{absorptivity} = \text{fraction of } G \text{ absorbed}$)
  - **Reflection** by the surface
    ($\rho = \text{reflectivity} = \text{fraction of } G \text{ reflected}$)
  - **Transmission** through the material
    ($\tau = \text{transmissivity} = \text{fraction of } G \text{ transmitted}$)
- Sum of $\alpha + \rho + \tau = 1$
Radiosity ($J$)

- Total radiation leaving a surface.
- Sum of emission plus reflected portion of irradiation.

**Example: Problem 12.43**

An opaque surface with the prescribed spectral, hemispherical reflectivity distribution is subjected to the spectral irradiation shown.

(a) Sketch the spectral absorptivity distribution
(b) Determine the total irradiation on the surface
(c) Determine the radiant flux that is absorbed by the surface
(d) What is the total absorptivity of this surface?
Gray Surface Behavior

Example: Problem 12.61

Four diffuse surfaces having spectral characteristics shown are at 300K and are exposed to solar radiation. Which of the surfaces may be approximated as being gray?
Figure 12.12  Spectral blackbody emissive power.