This course will introduce students to concepts in radiative heat transfer beyond what they learnt in undergraduate heat transfer and intermediate graduate heat transfer courses (ME 510 and 710). Primary emphasis will be on radiative properties of materials (gases, solids, real surfaces), and on the solution of the radiative transfer equation in both non-participating and participating media by using various analytical and numerical methods.


Topics Covered (tentative)
- Fundamentals: basic laws, underlying theories, and definitions
- Radiative (optical) properties of real surfaces from electromagnetic wave theory
- Radiation transport in Non-Participating Media
  - View factor calculations
  - Radiation exchange between gray diffuse surfaces
  - Radiation exchange between partially-specular and non-gray surfaces
  - The Monte Carlo Method for surface-to-surface radiation exchange
- Radiative (optical) properties of gases and gas mixtures, spectral lines, collision and doppler broadening, Lorentz and Voigt line shapes, determination of spectral absorption coefficient.
- Rayleigh and Mie scattering theory, determination of spectral scattering coefficient of gases and particulates
- Radiation Transport in Participating Media
  - The Radiative Transfer Equation (RTE)
  - Solution of the RTE
    - Analytical techniques for simple configurations
    - Method of Spherical Harmonics ($P_N$ approximation)
    - Discrete Ordinates Method ($S_N$ approximation)
    - The Monte Carlo Method
- Treatment of Non-Gray Radiation in Gases
  - Wide-band models
  - Narrow-band models
  - $k$-distribution models
- Coupling radiation with other modes of heat transfer (i.e., to the overall energy conservation equation)

Grading Policy
Homework (including a few extended project-like): 60%
Midterm Exam: 20%  Final Exam: 20%

Prerequisites: ME 710 and ME 707 preferred. Although other courses are officially listed as prerequisites for this course, they are not required. If you have problems registering because of not meeting official prerequisite requirements, please see the instructor.