ME151A/250A **Spring 2025**

Conductive and Radiative Transport

Instructor: Costas P. Grigoropoulos, 6129 EH, Phone: 510-642-2525

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Laser Thermal Laboratory http://ltl.berkeley.edu/

Class Schedule: M W 3:30-5 1165 EH

Office Hours:

M 11-12

Tue 1-2

or by appointment (e-mail to schedule).

Textbooks

D.W. Hahn, M.N. Ozisik, Heat Conduction, 3rd Edition, Wiley, 2012

J.R. Howell, R. Siegel and M.P. Menguc, Thermal Radiation Heat Transfer, 6th ed., CRC Press, 2015

Notes as well as the lecture transcripts will be posted on bcourses

References

H.S. Carslaw, and J.C. Jaeger, Conduction of Heat in Solids, Oxford University Press, 1959.

M.F. Modest, Radiative Heat Transfer, McGraw Hill, 2003.

M.Q. Brewster, Thermal Radiative Transfer and Properties, John Wiley, 1992.

M. Born, and E. Wolf, Principles of Optics, 7th Ed., Pergamon, 2000.

Description: The course will cover the analysis of steady and transient heat conduction by both analytical and numerical methods and the treatment of phase change problems. Furthermore, the course will cover radiative properties, the mechanisms of radiative transfer and will

present theory and methods of solution of radiative transfer problems in participating and nonparticipating media.

Contents

Week Topic

1 Equation of heat conduction for isotropic and anisotropic materials

2 Steady heat conduction - separation of variables, nonhomogeneous problems, sources and sinks

3 Unsteady heat conduction - separation of variables in the rectangular, cylindrical and spherical coordinate systems

4 Unsteady heat conduction – Duhamel's superposition theorem, instantaneous sources and sinks, moving sources of heat, the method of images, Green's functions

5 Laplace Transform, problems periodic in time

6 Phase change problems - melting and freezing - exact solutions, approximate solutions - the enthalpy formulation

7 Radiative properties of surfaces and simple transfer.

8 Configuration factors – radiative exchange between surfaces

9 Radiative transfer equation in absorbing, emitting and scattering media

10 Microscopic basis of gas radiation

11 Radiative properties of particles

12 Approximate solutions – gas radiation in enclosures – mean beam lengths

13 Combined modes of transfer

Midterm on Conduction on March 3

Midterm on Radiation on April 21

Final exam on May 14 7-10 pm (to be confirmed)

Grading: Midterms 25% each, Homework 10%, Final 40%