HEAT TRANSFER ME-346

Number of Lectures – 3 per week; Number of credits - 6

COURSE CONTENT

Introduction to heat transfer

- Introduction, Introduction to one dimensional conduction, conduction rate equation, thermal conductivity, thermal diffusivity
- Heat diffusion equation, Initial and boundary conditions,

Conduction

- One dimensional steady state conduction, Plane wall, composite wall, cylinder, sphere, Critical radius of insulation, summary of all cases
- One dimensional steady state conduction in plane wall and radial systems with thermal energy generation
- Fins - Fin efficiency, effectiveness, length of the fin, Transient conduction – Lumped capacitance, Heisler charts, semi-infinite medium.

COURSE CONTENT

Convection

Physical Mechanism on Convection, Classification of Fluid Flows, Velocity Boundary Layer, Thermal Boundary Layer, Laminar and Turbulent Flows, Heat and Momentum Transfer in Turbulent Flow, Derivation of Differential Convection Equations – Navier stokes equation, Differential Energy equation

Derive B.L. equations both momentum and heat transfer, Solutions of convection equations for a flat plate – Momentum and energy, Normalised dimensionless equations and similarity, anologies of heat transfer

Convective heat transfer in external flows – friction and pressure drag, heat transfer, flow over a flat plate, Flow and heat transfer across cylinders and spheres

Internal forced convection – average velocity and bulk mean temperature, laminar and turbulent flow in tubes, entrance region, entry lengths, constant heat flux and constant wall temperature, Laminar flow in tubes, Nu = 4.36 for constant heat flux derivation, Turbulent flow in tubes

Natural convection

COURSE CONTENT

Heat Exchangers

Types, overall heat transfer coefficient, fouling factor, Analysis of heat exchangers, Log mean temperature difference for parallel and counterflow heat exchangers, multipass and cross flow heat exchangers, use of correction factor, ε-NTU method, Effectiveness relations for all heat exchangers along with the charts, selection of heat exchangers

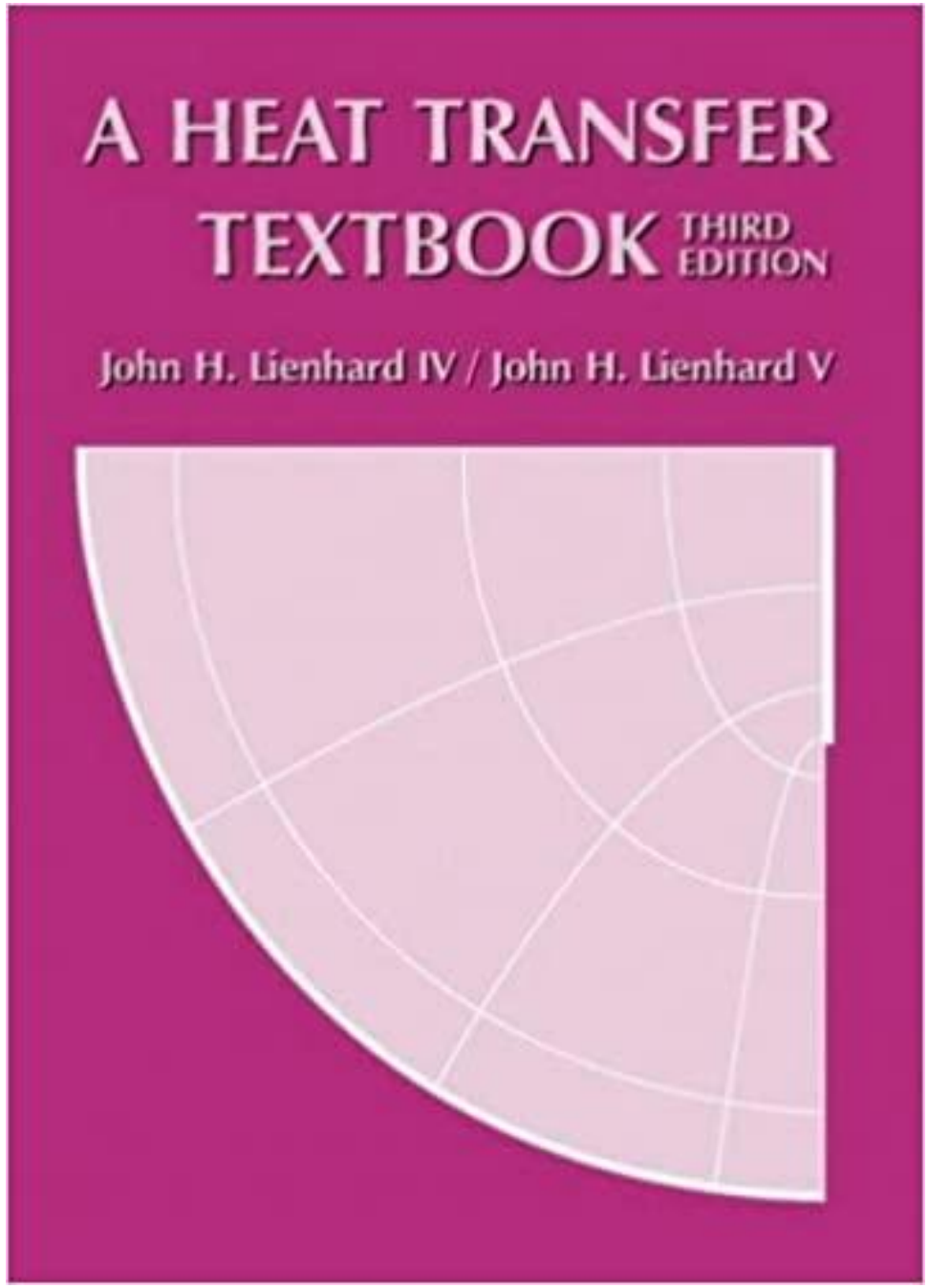
Thermal Radiation

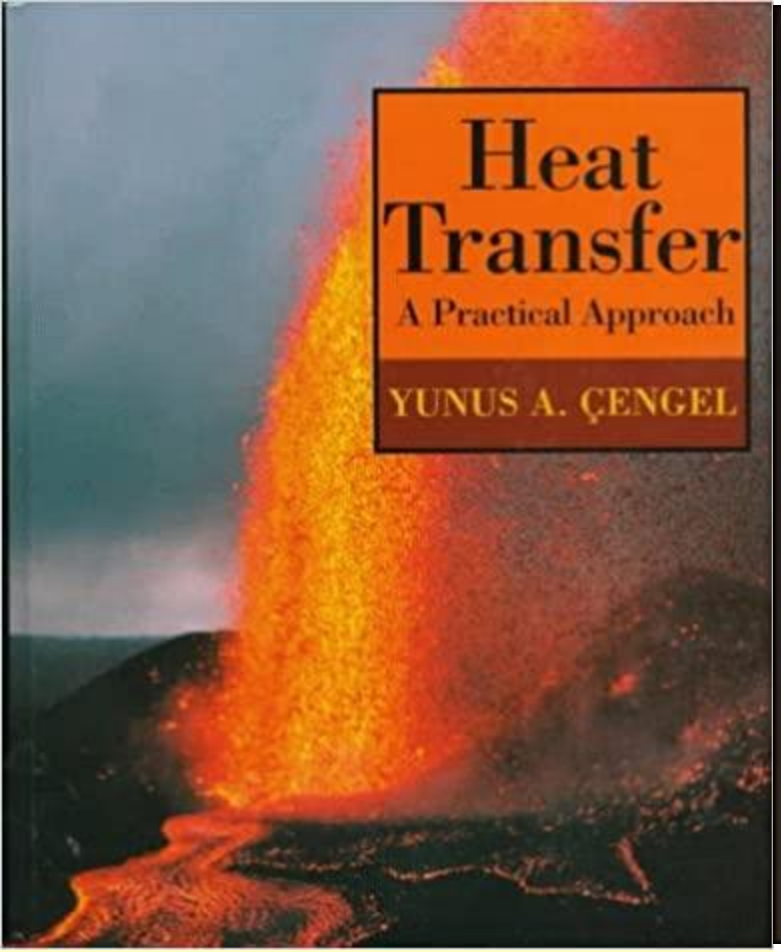
Introduction, thermal radiation, black body radiation – Stefan Boltzman law, Planck's law, Wien's displacement law, Radiation intensity, solid angle, intensity of emitted radiation, incident radiation, radiosity, spectral quantities, Radiative properties – emissivity, absorptivity, reflectivity, transmissivity, Kirchoff's law, Greenhouse effect, atmospheric and solar radiation, Radiation heat transfer – view factor, view factor relations

Black surfaces, diffuse and gray surfaces, Net radiation heat transfer between any two surfaces, methods of solving radiation problems, radiation heat transfer in two surface enclosure, Radiation heat transfer in three surface enclosure, radiation shields and radiation effects.

Text books and References

- Cengel Y.A, Heat transfer – A practical Approach, Second Edition, Tata McGraw Hill, New Delhi.
- Incropera F. P and Dewitt, Fundamentals of Heat Transfer, Fifth Edition, John Wiley and Sons (Asia) Private Limited, Indian edition.
- Sukhatme S.P., A Textbook on Heat Transfer, Orient Blackswan, 2006.
- Lienhard, J.H. IV and V, A Heat Transfer Textbook, 3rd edition – (downloadable from http://web.mit.edu/lienhard/www/ahtt.html)
- Holman J.P., Heat Transfer, Ninth Edition, Tata McGraw Hill, New Delhi.
- Ghoshdashtidar P.S, Heat Transfer, Oxford university Press, USA.
- Nag P.K., Heat and Mass Transfer, Second Edition, Tata McGraw Hill, New Delhi.
- Bejan A, Heat Transfer, John Wiley and Sons.
- Som S.K., Introduction of Heat Transfer, Prentice Hall of India Private Limited.





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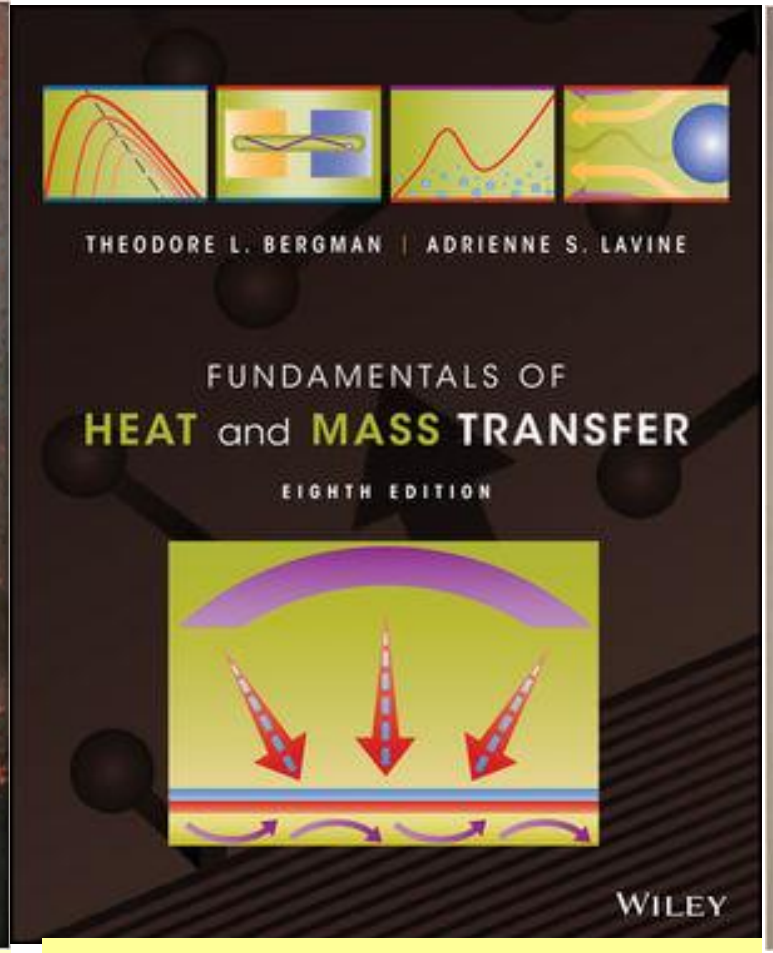

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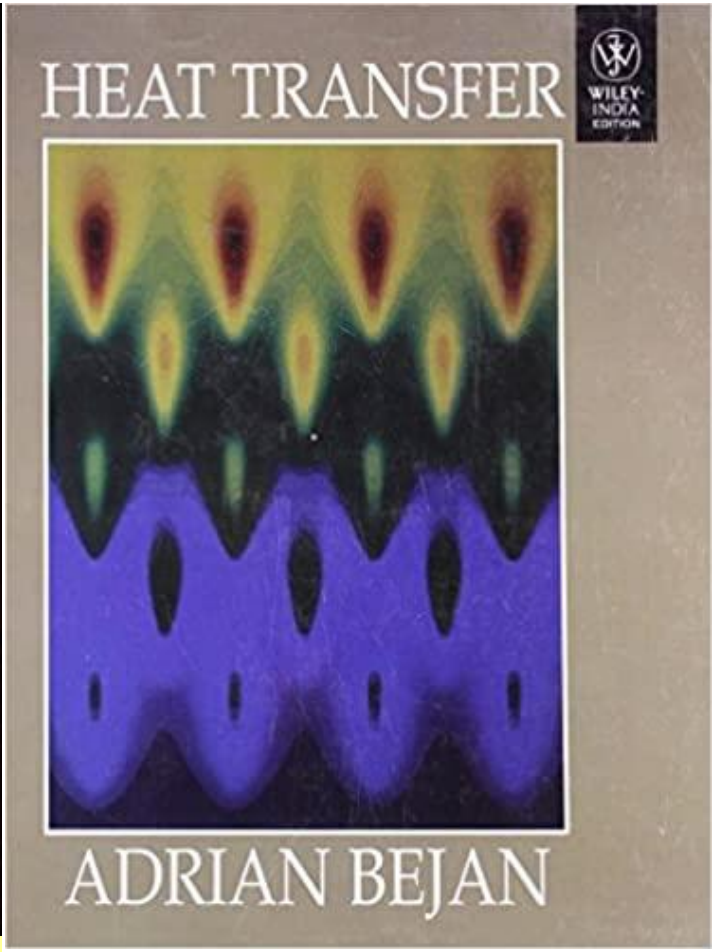
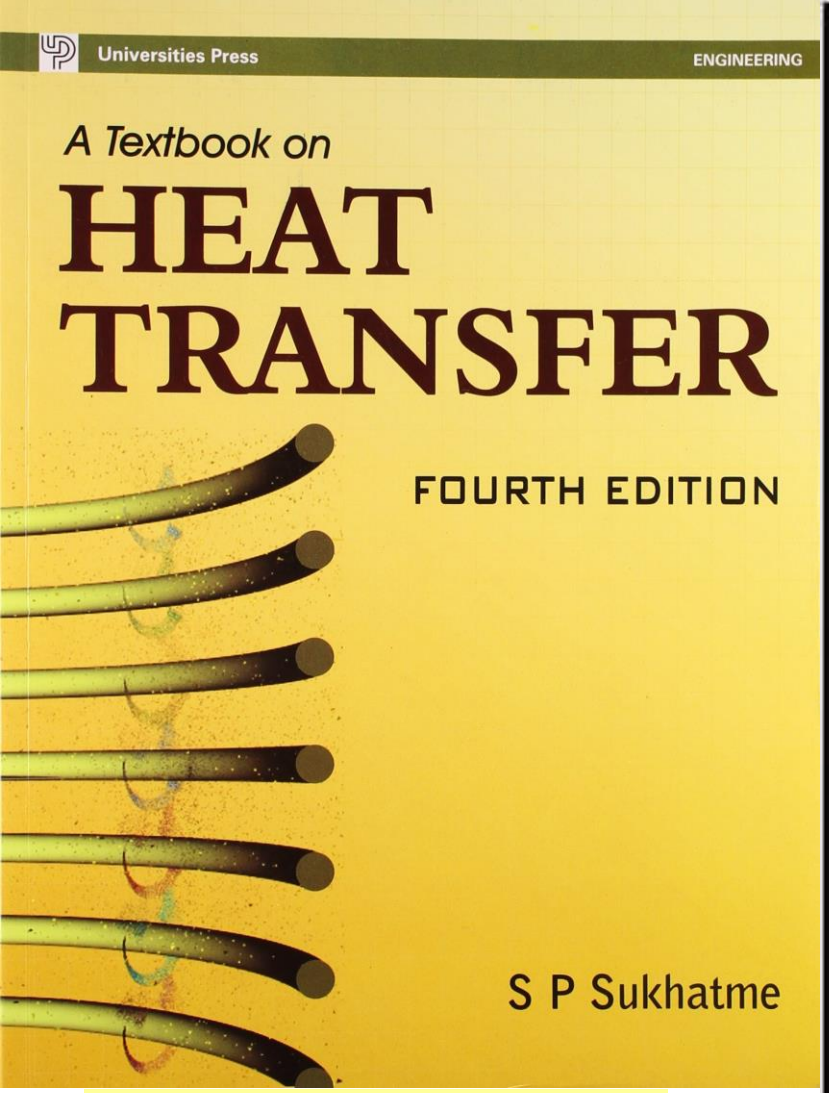
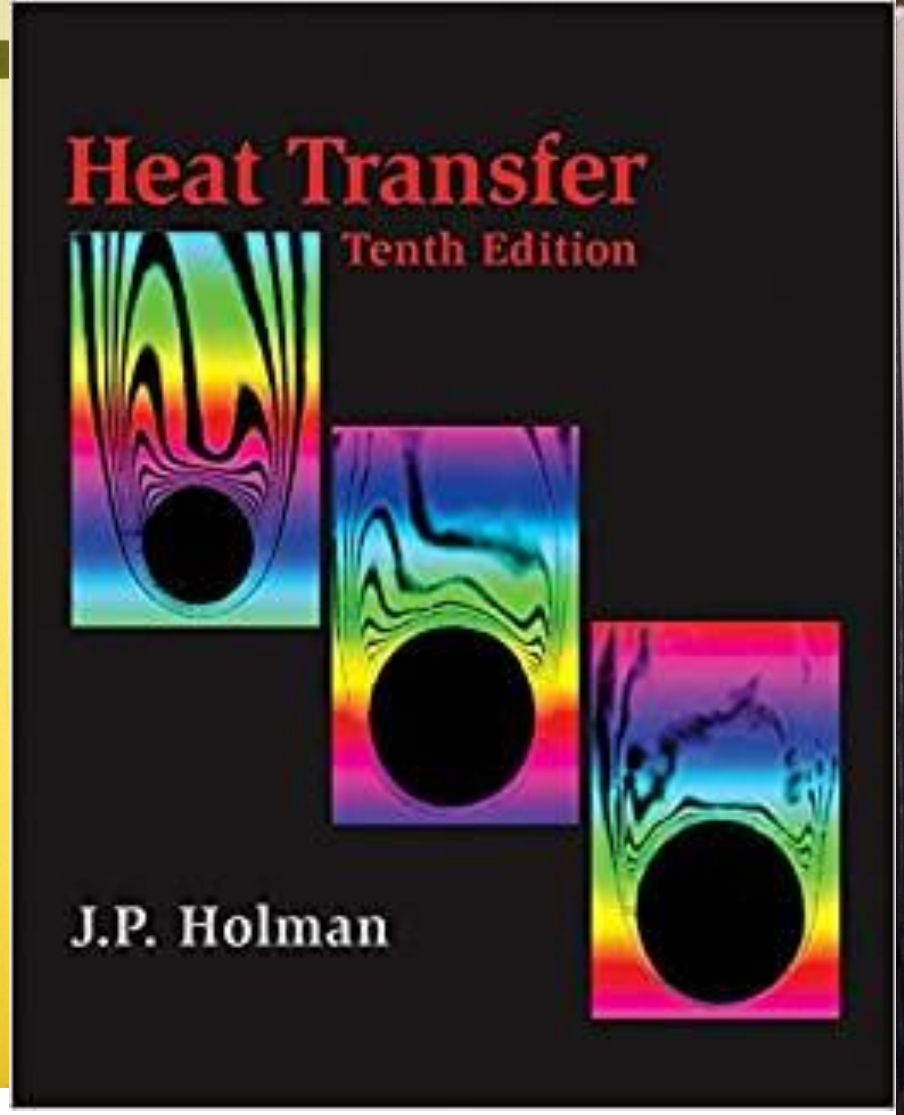


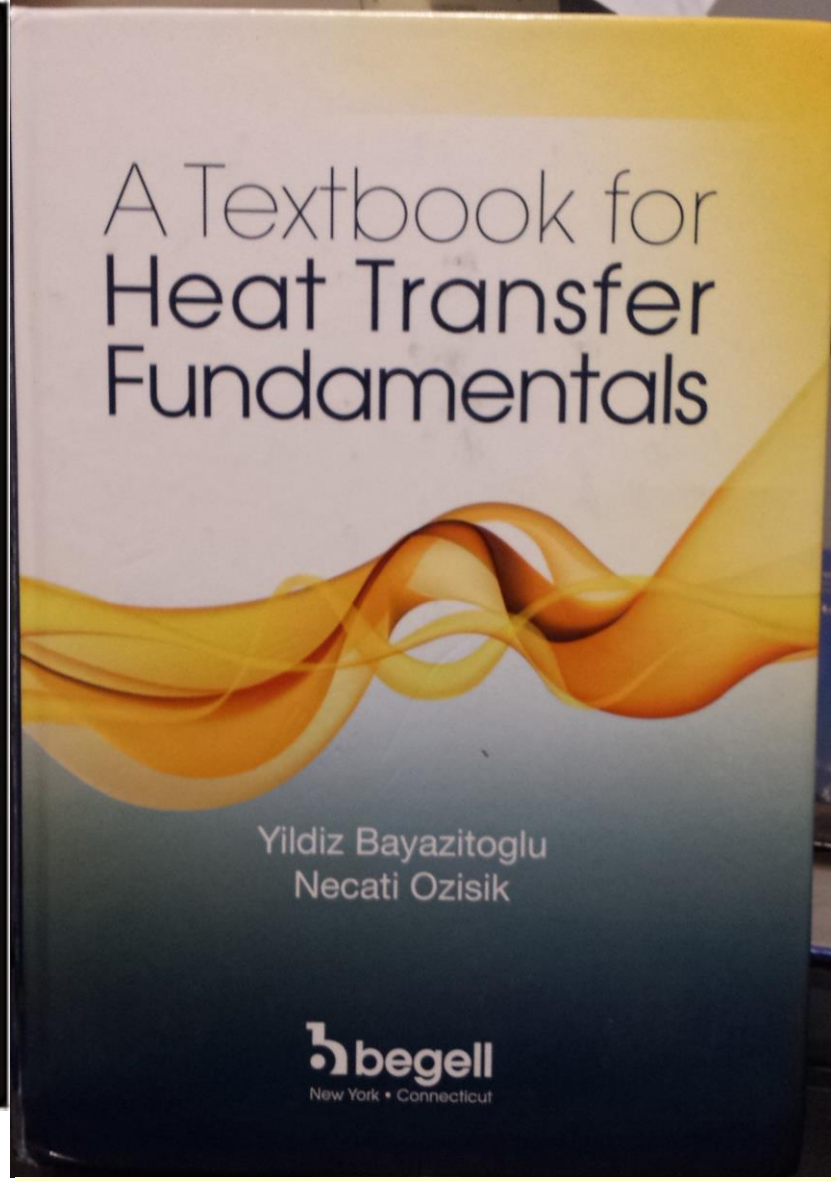
Bejan A, Heat Transfer, John Wiley and Sons.



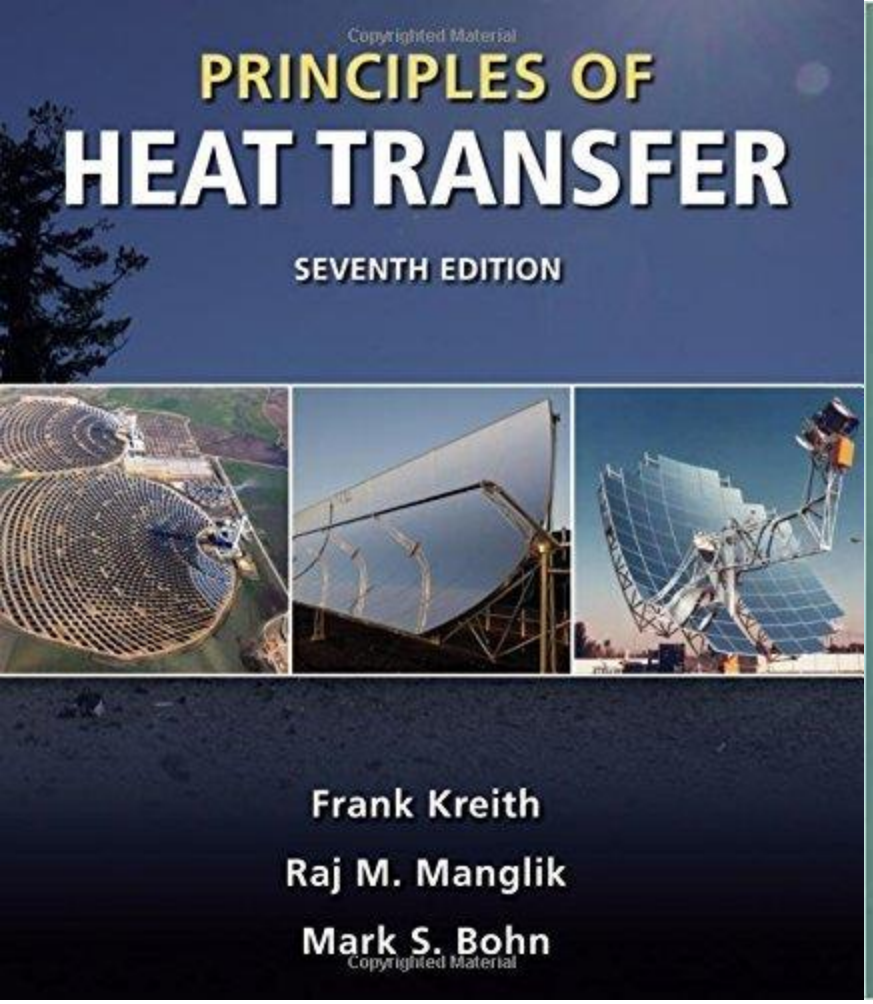
Sukhatme S.P., A Textbook on Heat Transfer, Orient Blackswan, 2006



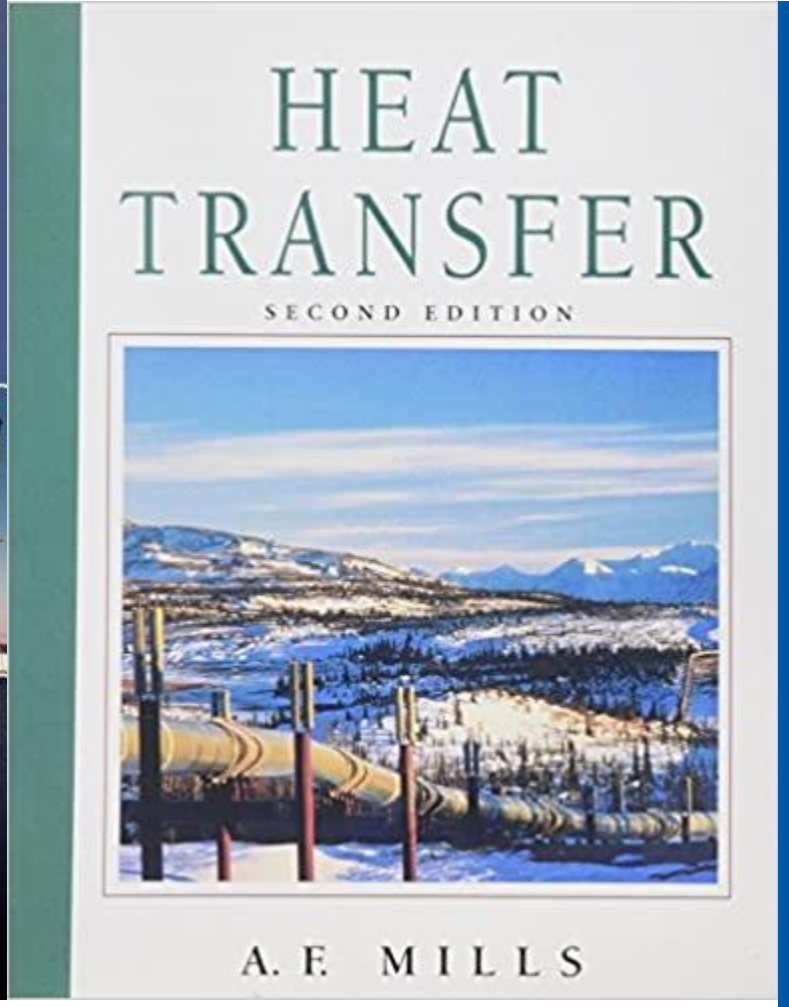
Holman J.P., Heat Transfer, Ninth Edition, Tata McGraw Hill, New Delhi.



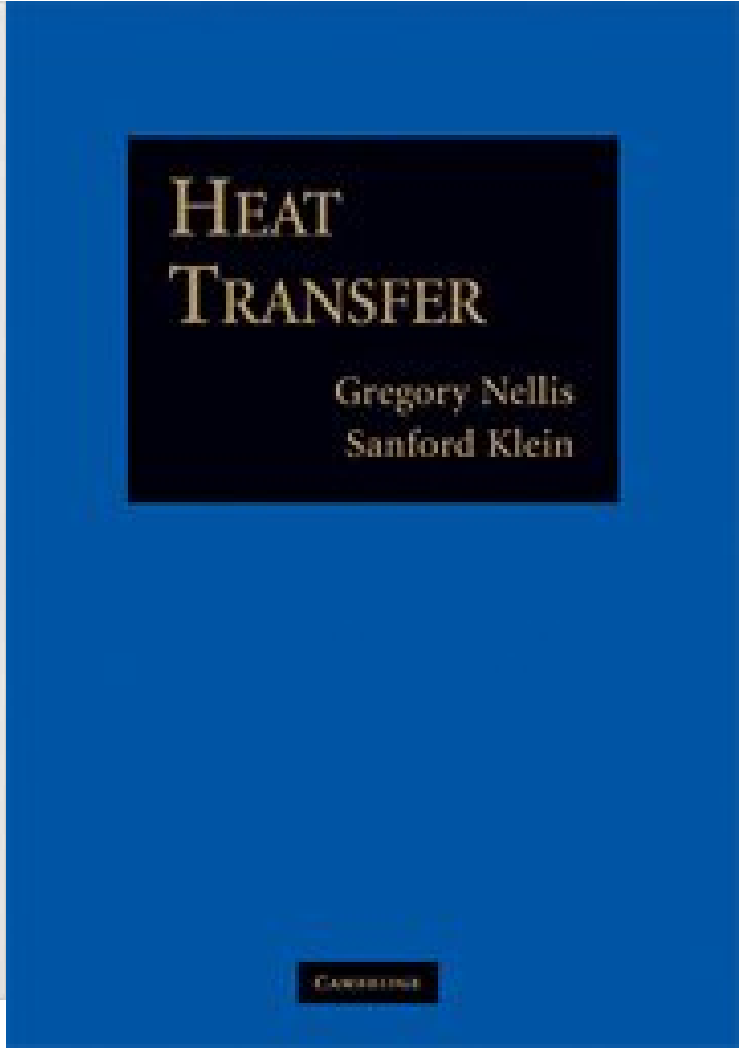
A text book for Heat Transfer Fundamentals, Yildiz Bayazitoglu and Necati Ozisik



Frank Kreith, Raj M Manglik, Mark S. Bohn, Principles of Heat Transfer, Seventh Edition,



A.E Mills, Heat Tranfer, Second Edition



Gregory Nellis and Sanford Klein, Heat Tranfer, Second Edition

METHOD OF TEACHING

- Online teaching is being used as method of teaching
- Videos would be recorded during the live lectures and would be shared through google drive immediately after the scheduled class
- Class notes (pdf) would be shared which can be used for study purposes, although students are highly encouraged to study text books as well
- Moodle would be used to share all the notes sent to you in advance so that you can watch and ask questions during the interaction in the classes
- Students are encouraged to attend the live lectures and ASK DOUBTS in the class as the concepts are taught
- Students who could not attend any particular lecture due to technical reasons (lack of power supply or internet connectivity) are encouraged to watch the videos shared so that they can catch up with the teaching material

EVALUATION METHODOLOGY

- **QUIZZES, MIDSEMESTER EXAMINATION AND ENDSEMESTER EXAMINATION**
  - There would be four to six quizzes spread out throughout the semester
  - Mid semester examination and end semester examination would be there
  - Weightages for each of the examination is as follows
    - **QUIZZES – 40 %**
    - **MIDSEMESTER EXAMINATION - 25%**
    - **ENDSEMESTER EXAMINATION - 35%**

Problem Solving Methodology: In this course, you are expected to solve all homework problems, quizzes, and exam problems following the Methodology discussed below

Briefly state the problem; do not repeat the problem statement. Use appropriate symbols to list known quantities.

Briefly state what is to be found.

Draw a schematic of the physical system. If conservation laws are used, indicate the required control volume or control surface by dashed lines. Use arrows to represent appropriate processes on the schematic.

List any simplifying assumptions that are made.

Compile property values, constants and other values that may be needed in subsequent calculations. Reference the Table number from where the values were obtained. If a graph is used, reference the figure number and the input and output parameter values.

Solve all problems using variables. Before the final answer is obtained, indicate the full equation with all numerical values substituted. This is particularly important for checking the correctness of units.

Give the final answer to three significant digits. Include appropriate units. A numerical answer without units is *meaningless*. Box the final answer. Give a thought whether the answer is realistic.

Discuss and comment on the result. This helps give a better physical understanding to the problem and the phenomenon involved. This is intended to help you think beyond 'plugging and chugging'.