

ME 791-015
Heat Transfer in Renewable Energy Systems
Spring 2009

Time: 1:00 ~ 2:15pm, MW

Location: EJCH 202

Background & Objective: Sustainable and renewable energy is of a paramount interest among the energy industries and the general public because of growing concern on limited energy resources and global climate change caused by greenhouse emission. The objective of the course is to introduce various analytical and optimization methods of heat transfer (conduction, convection and radiation) with a focus on renewable energy systems to Ph.D. and M.S. degree graduate students interested in pursuing the heat transfer at a more advanced level. The course will apply the heat transfer and engineering concepts to the renewable energy systems (e.g., solar, geothermal and wind) and the supporting technologies (thermal energy storage, solid state hydrogen storage/compression, fuel cell, rechargeable battery, and thermoelectric).

Instructor: Chanwoo Park, Rm: PE 209, Tel.: 682-6301 (office), email: chanwoo@unr.edu

Prerequisites: ME 314 (360) or equivalent

Office Hours: 2:30 ~ 4pm, MW

Textbook: Heat Transfer, A.F. Mills, 2nd ed., Prentice Hall, 1999

Grading Policy:

1. In-class Quizzes	15%
2. Homework	15%
3. Topical Project	
Project Plan/Progress Update	20%
Final PowerPoint Presentation	25%
Final Report	25%

In-class Quizzes: Short Quizzes based on reading assignments and lecture material are administered during the lecture period. Make-up quizzes will not be given.

Homework: Please review the [ME Department policy](#) on homework. Homework must be turned in at the BEGINNING of the lecture. Homework is not accepted late. It is our expectation that students will discuss assignments with each other. However, we also expect that students will submit work that is only their own. Misrepresentation in this context is a violation of both the University and Engineering Codes of Ethics.

Topical Project: Analysis and literature survey of selected problems. The topical project report will include the following elements and not limited to the following: (1) Introduction of topical project (scope and objective); (2) Description of the technical approach employed (include but not limited to assumptions and equations); (3) Results (include pertinent figures; tabulate property values and dimensional constants); (4) Discussion and Conclusions; (5) Appendix containing any computer program listing, design drawings and reference (industry standards, sample products, supplier list and

web-site address etc.). Topic selection and draft research plan deadline is February 11. Mid-term Progress report is due on March 11. Final PowerPoint presentation (20 minute presentation and 10 minute question session) and Final report (5 pages + appendices and graphics) is due on 5/6. Attendance for the presentation is mandatory for ALL students.

Grading Schedule : Letter grades will be assigned according to the following schedule.

$A \geq 90$, $87 \leq B+ < 90$, $80 \leq B < 87$, $70 \leq C < 80$, $60 \leq D < 70$, $F < 60$

Course Coverage:

1. Overview of Renewable Energy Systems
2. Conduction: Steady and Transient
3. *Case Study 1:* Thermoelectric Power Generation
4. Convection: Internal/External; Forced/Natural, Heat Exchanger
5. *Case Study 2:* Thermal Energy Storage and Hydrogen Storage/Compression
6. *Case Study 3:* Rechargeable Battery Thermal Management
7. Radiation: Surface and Solar Radiation
8. *Case Study 4:* Solar Hot Water and Solar Refrigeration System
9. Phase Change: Condensation and Boiling
10. *Case Study 5:* Geothermal Power Generation

References:

1. A.V. Rosa, "Fundamentals of Renewable Energy Resources", Elsevier Academic Press, 2005.
2. F. Kreith and D. Y. Goswami, "Handbook of Energy Efficiency and Renewable Energy", CRC Press, 2007.
3. G.N. Tiwari and M.K. Ghosal, "Fundamentals of Renewable Energy Sources", Alpha Science International, 2007
4. R. O'Hayre, S.-K. Cha, W. Colella and F.B. Prinz, "Fuel Cell Fundamentals", Wiley, 2009.
5. M. Kaviany, "Principles of Heat Transfer", 2nd ed., 1995, 2nd corr. 2nd printing, 1999, Springer-Verlag.
6. J.A. Duffie and W.A. Beckman, "Solar Engineering of Thermal Processes", 2nd ed., Wiley-Interscience, 1991.
7. I. Dincer and M. Rosen, "Thermal Energy Storage: Systems and Applications", 1st ed., Wiley, 2002.
8. G. Masters, "Renewable and Efficient Electric Power Systems", 1st ed., Wiley-IEEE Press, 2004.
9. A. Bejan, "Thermal Design and Optimization", 1st ed., Wiley-Interscience, 1995.
10. Y. Jaluria, "Design and Optimization of Thermal Systems", 2nd ed., CRC, 2007.
11. R. Siegel, "Thermal Radiation Heat Transfer", 4th ed., Taylor & Francis, 2001.
12. J.G. Collier and J.R. Thome, "Convective Boiling and Condensation," 3rd ed., Oxford University Press, 1996.