MEEN 5315 Nanoscale Energy Transport – Spring 2020

(3 credits)

Catalog Description:
Microscopic concepts and methodology in thermal science, including equilibrium statistics, Boltzmann transport equation, and nano-microscale heat conduction and radiation, with applications in contemporary technologies.

Hard-Copy Textbook:
Zhuomin Zhang, *Nano/Microscale Heat Transfer*, McGraw-Hill, New York, 2007.

Prerequisite: MEEN 3210 or equivalent.

Time&Place: Tue. & Thur. 10:00 – 11:20 AM @ DP D215

Office hours: Tue. & Thur. 2:30 – 4:00 PM @ DP F101R, or Email me at zihao.zhang@unt.edu for an appointment.

Topics covered and approximate lectures (attendance is required)

⇒ Review of macroscopic transport theory; introduction to microscale phenomena and nano-science and technology – **2** (Ch. 1, 2)

⇒ Statistical mechanics and equilibrium distributions, quantum statistics, specific heat of ideal gases – **4** (Ch. 3)

⇒ Basic kinetic theory and transport properties of ideal gases – **2** (Ch. 4)

⇒ Microfluidics and microscale convection heat transfer – **2** (Ch. 4)

⇒ Properties of solids: specific heat and quantum size effect, thermal conductivity of solids; thermal conductivity of thin films (boundary scattering); thermoelectricity and applications – **4** (Ch. 5)

⇒ Understanding solids and band structures – **4** (Ch. 6)

⇒ Non-Fourier heat conduction: nonequilibrium pulsed laser heating, the Boltzmann transport equation – **2** (Ch. 7)

⇒ Time permitting: Micro/nanoscale thermal radiation: history of thermal radiation and the derivation of Planck's law – **2** (Ch. 8)

⇒ Chs. 8-10 will be covered in Fall 2020: MEEN 5800 Optics & Thermal Radiation

Homework and exams: 8 assignments (you may drop one and only 7 will be counted; discussions encouraged, but you should not collaborate), an in-class test, a take-home exam, and a term paper + presentation (individual).

Grading method: Homework: 35%, Midterm 1: 20% Midterm 2: 20% (take-home), and Individual term paper (10 pages) and presentation (15 minutes): 25%.

In-class midterm on February 25 (Tuesday), open everything, but no phones. You can use your computer to read materials or do calculations (though a calculator is sufficient).

48-hour at-home midterm during April 7-April 9. No class, but there will be video lectures. You may use internet but no teamwork or questions allowed. Turn in on Canvas.