Lecture 1 – Introduction and class policies

Purdue ME 200, Thermodynamics I

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Outline

What is thermodynamics?

- the science of **energy** (the capacity to cause change)
- thermodynamics deals with two familiar quantities
  - ⋄ kinetic energy (KE) due to macroscopic motion
  - ⋄ potential energy (PE) associated with large-scale forces
- it also introduces **internal energy**, a macroscopic summary of
  - ⋄ KE due to microscopic motion (of molecules, atoms, particles)
  - ⋄ PE due to small-scale forces
- thermodynamics focuses on **energy transfer** via
  - ⋄ **work** (driven by forces acting over displacements)
  - ⋄ **heat transfer** (driven by temperature differences)
  - ⋄ **mass transfer** (macroscopic motion of matter)

What can thermodynamics do?

- help design and analyze many engineered systems
  - ◇ car, truck and jet engines
  - ◇ fossil-fueled, nuclear and renewable power plants
  - ◇ refrigerators, air conditioners and heat pumps
- help understand many natural phenomena
  - ◇ molecules
  - ◇ organisms
  - ◇ weather and climate
  - ◇ stars, black holes and the universe itself. . .

What is thermodynamics like?

- like mechanics, thermodynamics is based on a few simple laws
  - ⋄ conservation of mass
  - ⋄ conservation of energy
  - ⋄ increase of **entropy** (a measure of disorder)
- but thermodynamics tends to be more abstract
  - ⋄ the properties it covers are further from our sensory experience (e.g., pressure and temperature rather than force and velocity)
  - ⋄ it relies much less on the shapes and configurations of objects
- thermodynamics is fairly light on math
  - ⋄ mostly algebra and arithmetic
  - ⋄ some partial derivatives and (path) integrals

What does (classical, equilibrium) thermodynamics cover?
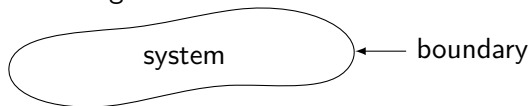
- the basic object of study is a **system**
  - ◇ an **open system** or **control volume** is a region of space
  - ◇ a **closed system** or **control mass** is a collection of matter
  - ◇ an **isolated system** has no interaction with the surroundings
    (the **surroundings** are everything but the system)
- the focus is on systems in **equilibrium**
  (when isolated, their properties don't change)
- this class deals mainly with macroscopic properties:
  mass, energy, volume, pressure, temperature, entropy, . . .
- a microscopic view explains more, but with much more math

Einstein on thermodynamics

> *A theory is the more impressive the greater the simplicity of its premises, the more different kinds of things it relates, and the more extended its area of applicability. Therefore the deep impression that classical thermodynamics made upon me. It is the only physical theory of universal content which I am convinced will never be overthrown, within the framework of applicability of its basic concepts.*

Einstein, A. and Schilpp, P. (editor): **Autobiographical Notes.** Open Court Publishing (1979) p. 31.

Outline

Homework

- ~40 homework problems over the semester
- 15% of total grade
- due Friday nights, submitted on Gradescope
- no late homework accepted
- but we'll drop the lowest 5 homework problem scores
- work with friends, but write up your own solutions

To really learn, try problems **without looking at solutions!**

Exams

- 3 midterms and a cumulative final
- exams are 85% of total grade
  - ◇ 60% midterms (20% each)
  - ◇ 25% final
- make-up exams offered only under MEAPS rules

Reading and lectures

- book: Moran, *Fundamentals of Engineering Thermodynamics*
- 7th, 8th or 9th edition is fine
- reading assignments refer to 8th edition
- lectures are a complement to, not substitute for, the reading
- you're accountable for all material in assigned readings (whether or not it appears in lecture)

Other resources

- there are ~600 students, 5 professors and 7 TAs in this class
- any student can go to office hours with any professor or TA
- collectively, office hours will ~cover 9 AM – 9 PM, Mon – Fri
- Brightspace has homework, lectures, etc.
- homework submitted via Gradescope
- discussion with peers, TAs and professors on Piazza
- BoilerConnect provides free tutoring
- YouTube explainers, MOOCs, online notes, other books, . . .

This week's assignments

- Reading: 1.2-1.3, 1.5-1.7, 1.8.2, 1.9
- Homework 1 and 2 due Friday, 1/13

Questions?