Thermodynamics of Materials

2008년 1학기

담당교수 : 황 농 문

"The subtleties of the subject are all but ignored, as a result of which the arrival of the student at the wrong numerical answer is caused by his plugging the wrong numbers in the wrong places in the wrong equation."

D.R. Gaskell

Thermodynamics has been developed over a long period of time, accumulating the wisdoms and efforts of numerous genii.

Fundamental principles of natural phenomena are concentrated in thermodynamic laws.

“There is an unwritten axiom of thermodynamics which states that nobody understand thermodynamics the first time they study it.”

J.F. Bredt

Thermodynamics is a funny subject.
The first time you go through it, you don't understand it at all.

The second time you go through it, you think you understand it, except for one or two small points.

The third time you go through it, you know you don't understand it, but by that time you are so used to it, it doesn't bother you anymore.

-Arnold Sommerfeld

"I did not learn thermodynamics
by reading the textbooks,
but I learned it by thinking.

Thinking is the best way
to conquer thermodynamics."

M. Hillert

References

1. D.R. Gaskell, “Introduction to the Thermodynamics of Materials”, Third Edition, Taylor & Francis, 1995

2. R.T. DeHoff, “Thermodynamics in Materials Science”, McGraw-Hill, 1993.

3. J.B. Fenn, “Engines, Energy, and Entropy”, W.H. Freeman and Company, 1982

4. D. Kondepudi and I. Prigogine, Modern Thermodynamics, John Wiley & Sons (1998).

5. M. Hillert, Phase Equilibria, Phase Diagrams and Phase Transformations, Cambridge University Press (1998)

6. Various teaching materials related to thermodynamics from the internet

강의계획

제 **1-5** 주 **Fundamental concepts of thermodynamics**

- **First and Second Laws of Thermodynamics**
- **Concept of Entropy**
- **Uncompensated Heat and Entropy as a Universal Criterion for Irreversibility**
- **Relation between Entropy and Gibbs (and Helmholtz) Free Energy**
- **Statistical Mechanics**
- **Comparison between thermodynamics and kinetics**

제 **6-9** 주
- Stability of Closed and Open Systems
- Chemical Potential and Activity
- Chemical Reactions between Solids and Gas

제 **10 -16** 주

Thermodynamics of Thin Film Process
- Thermodynamics in Chemical Vapor Deposition
- Thermo-Calc

성적평가방법

중간고사 (40%),
기말고사 (40%)
HW, QA (10%)
출석 (10%)

Fundamental Concepts
of Thermodynamic Parameters

1. Temperature
2. Pressure
3. Heat
4. Heat Capacity
5. Energy

Fundamental Concepts

6. Internal Energy
7. Enthalpy
8. Entropy
9. Free Energy (Gibbs, Helmholtz)
10. Chemical Potential

Greek meanings of Energy, Enthalpy and Entropy

En = internal
ergy = motion
thalpy = warmth
tropy = shape

1. Temperature
   → Hotness

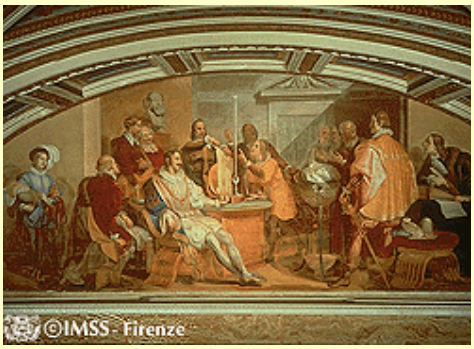
How does it differ from heat?

How do we measure it?
   → Thermometer

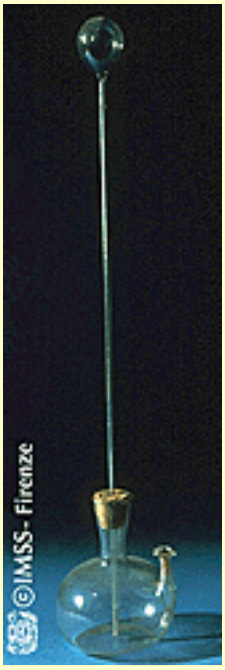
The first thermometer was invented in the 17th century.
→ Italian, Santorio Santorio (1561-1636)

Invent it yourself with the background knowledge of the 17th century.

Galileo GALILEI
Pisa 1564 - Arcetri, Florence 1642



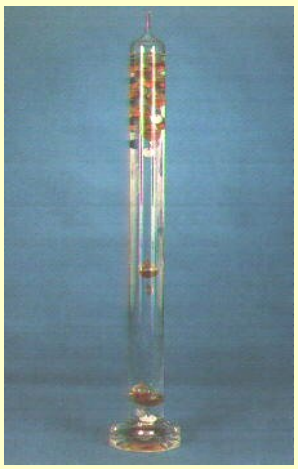
http://galileo.imss.firenze.it/museo/4/eiv07.html



Nineteenth century reproduction.
Glass. Height: 460 mm

http://galileo.imss.firenze.it/museo/4/eiv07.html

Galilei Thermometer



http://www-toys.science.unitn.it/toys/en-html/en-t-galileo.html

Temperature Scale

After thermometers were invented, different thermometers used different temperature scales.
→ Standardization was necessary.

Invent it yourself with the background knowledge of the 17th century.
What are the most important factors?

1. Fixed points
2. Within temperature domain of practical interest