MAT 501 Thermodynamics
Fall 2024

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Course Data: Meeting Hours(Places): Mon 12.40-14.30(G032)/Tue 08.40-09.30(G035)
Office hours: *TBA*

Textbooks:

Callen, H.B., *Thermodynamics and an Introduction to Thermostatistics*, Wiley, 2nd Ed., 1985. QC311 .C35 1985.

Fermi, E., *Thermodynamics*, Dover, 1956. QC311 .F47 2010,

References:

Atkins, P. and **J. de Paula,** *Physical Chemistry*, Eight Ed. W.H. Freeman and Company, 2006. QD453.2 .A85 2002.

Reif, F., *Fundamentals of statistical and thermal physics*. McGraw-Hill, 1965. QC175 .R44 1965.

Weeks Commencing/Topics:

Sep 23, 30 Part I
Thermodynamic systems
Piston-gas as a system
- Idealizations and assumptions about the piston, the gas, and the environment

Gases
- Ideal/perfect – what are the assumptions?
- Laws – observations/experiments
- Maxwell's "kinetic" theory

Work done

Oct 7, 14 Part II
Internal energy
- Isolated systems

Heat
- Interactions with the environment – Isothermal, adiabatic, and all else

The first law
- Gases
- Expansions – what variables are fixed? Reversibility for each step or whole process?

The maximum work theorem

Oct 21, Oct 28 Part III
The second law
Cycles
- Carnot – why Carnot? Are there other cycles? A general form of cycles
- Inverted heat engines: Refrigerators and pumps

Entropy
The fundamental equation – and its consequences
(Oct 29, Republic Day)

Nov 4-5 Recapitulation and **Exam I**

Nov 11, 18 Part IV
Thermodynamic potentials
Helmholtz and Gibbs free energy
Legendre transformations
The Maxwell relations
Thermodynamic description of mixtures

Nov 25, Dec 2 Part V
Stability of Thermodynamic Systems
Explain, why
Addition of heat to a stable system must increase its temperature
Isothermal expansion of a stable system must decrease its pressure
Le Châtelier's principle and Braun's amendment
Phase diagrams
Stabilities of phases
Phase boundaries and typical phase diagrams

Dec 9, 16 Part VI
Phase transitions
First-order phase transitions in single component systems
The discontinuity (of the volume – the lever rule; in the entropy – latent heat)
Phase loci – The Clapeyron equation
First order transitions in multicomponent simple systems – Gibbs' phase rule

Dec 23-24 Recapitulation and **Exam II**

Dec 30
Phase diagrams for binary systems
Entropy revisited
The Nernst postulate and the Third Law
Recapitulation and the **Final** prep

Class Policies

Course will be in physical mode

Problem sets are prepared for students to test their fundamental understanding. Students do not have to turned their solutions in; namely, they are not to be graded. Most of the time, a week (or so) after the assignment, the solution set will be posted on SU-Course.

Grading

Exam I and II: 30% each, total is for 60% of the final grade
Final exam: 40% of the final grade; covers all the material