ENS 202 Thermodynamics

Intended Audience: An introductory undergraduate level course for all interested FENS students, particularly those intending to major in BIO, MAT or ME programs.

Scope: To expose the students to the basic concepts related to the equilibrium properties of systems.

Aims: To equip the students with a basic understanding of "equilibrium" so that they can (i) perform the energy balance for a system and analyze the energy transfer processes in the system; (ii) interrelate various thermodynamic functions so that hard-to-measure properties may be determined through the measurable ones; (iii) develop a basic understanding of phase behavior. To furnish the students with an understanding of the relationship between microscopic level events and the macroscopically determined thermodynamical properties.

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Hours: **Lecture** – M 15:40 – 17:30 (FASS 1096); W 12:40 – 13:30 (FENS L063)
Recitation – F 8:40 – 9:30 (L055) section A
F 13:40 – 14:30 (L062) section B

Textbook: **Thermodynamics of Materials, Vol. I** by D.V. Ragone (ISBN 0-471-30885-4)

Supplementary material:
Physical Chemistry by Atkins & de Paula
Thermodynamics by Çengel & Boles
Molecular Driving Forces by Dill & Bromberg

Evaluation will be based on two midterms (25 % each), final exam (35 %), regular quizzes during the recitations (15 %; best 8 of 11).

Exam dates: **MT1** – Nov. 6 (Friday evening); **MT2** – Dec. 14 (during class hours); **Final** – to be announced.

Brief outline:

The first law (ch 1)	Introduction. General concepts and definitions. Understanding equilibrium.	2 weeks
The second law (ch 2)	Entropy. Reversible processes. Heat engines.	2 weeks
Property relationships (ch 3)	Other useful thermodynamic quantities. Legendre transformations and Maxwell relations.	2 weeks
Equilibrium I (ch 4)	Physical equilibrium. Phase transitions. Phase diagrams of single-component systems.	1 week
Equilibrium II (ch 5)	Chemical equilibrium. Activity. The equilibrium constant.	1 week
Solutions (ch 7)	Partial molar quantities. Ideal and non-ideal solutions.	1 week
Phase diagrams (ch 8 & 9)	The phase rule, the lever rule, stability. Eutectic diagrams. Ternary diagrams.	1 week
The microscopic view (ch 10)	Introduction to statistical thermodynamics. The third law.	2 weeks
Electrochemistry (ch 6)	Electrochemical cell. Some applications	1 week

Timetable of events in ENS 202

28/09	Mon	Intro & Ch1		04/11	Wed	Ch 3		09/12	Wed	Review
30/09	Wed	Ch 1		06/11	Fri	Midterm 1		14/12	Mon	Midterm 2
05/10	Mon	Ch 1		09/11	Mon	Ch 4		16/12	Wed	No class
07/10	Wed	Ch 1		11/11	Wed	Ch 4		21/12	Mon	Ch 10
12/10	Mon	Ch 2		16/11	Mon	Ch 5		23/12	Wed	Ch 10
14/10	Wed	Ch 2		18/11	Wed	Ch 5		28/12	Mon	Ch 10
19/10	Mon	Ch 2		23/11	Mon	Ch 7		30/12	Wed	Ch 10
21/10	Wed	Ch 2		25/11	Wed	Ch 7		04/01	Mon	Ch 6
26/10	Mon	Ch 3		30/11	Mon	No class		06/01	Wed	Ch 6
28/10	Wed	No class		02/12	Wed	Ch 8&9				
02/11	Mon	Ch 3		07/12	Mon	Ch 8&9		???	???	Final