PHYS 607 Syllabus **MWF 10:20 – 11:10 , Room 107** *Instructor: Artem G. Abanov*

Statistical Mechanics and Thermodynamics I. Spring 2013

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"Ludwig Boltzmann, who spent much of his life studying statistical mechanics, died in 1906, by his own hand. Paul Ehrenfest, carrying on the work, died similarly in 1933. Now it is our turn to study statistical mechanics."

- From the introduction to States of Matter by David L. Goodstein -

Text: This book is required.

- **L.D. Landau, E.M. Lifshitz et al**, *Statistical Physics*, 3rd edition, Butterworth-Heinemann, ISBN 0750633727.

  This book is recommended.

- **R. Kubo et al**, *Statistical Mechanics*, 12th repr. 1992 edition, Elsevier Science, ISBN 0444871039

Grading:

2 exams	50%
Final (comprehensive)	30%
Homework (weekly)	20%

Evening exams on **March 1** and **April 5**; 7:00-9:00 pm; MPHY 213
Final exam: **May 7**, Tuesday, 8-10 a.m.

Syllabus:

Wk	Date	Topic	Sections in Text
1	Jan. 14	**Lecture 1. Thermodynamics. Entropy.**	LL 9
	Jan. 16	**Lecture 2. Temperature. Macroscopic motion.**	LL 9, 10
	Jan. 18	**Lecture 3. Thermodynamic potentials**	LL 14,15,16
2	**Jan. 21**	**No classes. Martin Luther King, Jr. Day.**	
	Jan. 23	**Lecture 4. Relation between measurables. Joule-Thomson process.**	LL 18
	Jan. 25	**Lecture 5. Maximum work.**	LL 19
3	Jan. 28	**Lecture 6. Thermodynamic inequalities.**	LL 20,21,23
	Jan. 30	**Lecture 7. Dependence on the number of particles.**	LL 24
	Feb. 1	**Lecture 8. Chemical potential**	LL 24
4	Feb. 4	**Lecture 9. Equilibrium and chemical potential.**	LL 25
	Feb. 6	**Lecture 10. Phase Transitions.**	LL 81,82
	Feb. 8	**Lecture 11. Phase Transitions. Continued.**	LL 81,82
5	Feb. 18	**Lecture 12. Mixtures.**	LL 88,93
	Feb. 20	**Lecture 13. Classical statistical mechanics**	LL 1
	Feb. 22	**Lecture 14. Stat. independence & fluctuations.**	LL 2
6	Feb. 25	**Lecture 15. Fluctuations of additive observables.**	
	Feb. 27	**Lecture 16. Liouville's theorem.**	LL 3,4
	Mar. 1	**Lecture 17. Microcanonical distribution. Quantum.**	LL 4
7	Mar. 4	**Lecture 18. Statistical matrix. Quantum Liouville's theorem**	LL 5,6
	Mar. 6	**Lecture 19. Role of energy. Quantum microcanonical distribution.**	LL 6
	Mar. 8	**Lecture 20. Entropy.**	LL 7

8	Mar. 11	**Spring break.**	
	Mar. 13		
	Mar. 15		
9	Mar. 18	**Lecture 21. WKB. Level spacing. Quantum microcanonical distribution.**	LL 6
	Mar. 20	**Lecture 22. Gaussian Integrals.**	LL 110,111
	Mar. 22	**Lecture 23. Fluctuations of fundamental thermodynamical quantities.**	LL 112
10	Mar. 25	**Lecture 24. Canonical distribution.**	LL 28
	Mar. 27	**Lecture 25. Maxwell distribution.**	LL 29
	Mar. 29	**Reading day, no classes.**	
11	Apr. 1	**Lecture 26. Ising model.**	
	Apr. 3	**Lecture 27. Thermodynamic perturbation theory.**	LL 30,32
	Apr. 5	**Lecture 28. Grand canonical ensemble.**	LL 35
12	Apr. 8	**Lecture 29. Occupation numbers.**	LL 53,54,37
	Apr. 10	**Lecture 30. Classical Ideal gas.**	LL 41,42
	Apr. 12	**Lecture 31. Internal degrees of freedom.**	LL 44, 45, 46, 47, 49
13	Apr. 15	**Lecture 32. Magnetism of gases.**	LL 52
	Apr. 17	**Lecture 33. Fermi and Bose gases.**	LL 53, 54, 55
	Apr. 19	**Lecture 34. Degenerate electron gas T = 0.**	LL 57
14	Apr. 22	**Lecture 35. Degenerate electron gas.**	LL 58
	Apr. 24	**Lecture 36. Magnetism of degenerate electron gas.**	LL 59, 60
	Apr. 26	**Lecture 37. Degenerate Bose gas.**	LL 62
15	Apr. 29	**Lecture 38. Black-body radiation.**	LL 63
	Apr. 30	**Lecture 39. Phonons.**	LL 64, 65, 66
	The End!		
16		**Lecture 40. Non-Ideal gas. Van der Waal's equation.**	LL 74, 76, 84
		Lecture 41. Second order phase transitions.	LL 142, 144, 146, 148
		Lecture 41. FDT	LL 124, 125

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