PHYS 743 – Statistical Mechanics, Fall 2017
Syllabus

Prerequisites: PHYS 341, 343 or Permission of Instructor.

Textbooks:
L.D. Landau and E.M. Lifshitz, *Statistical Physics* (Elsevier), ISBN 978-0-7506-3372-7
R. Reif, *Fundamentals of Statistical and Thermal Physics* (McGraw-Hill), ISBN 07-051800-9

Class Time and Location: M, W 1:00 PM - 2:15 PM; CB 106
Course Instructor: Dr. A. G. Petukhov
Office: 223, EEP
Office Hours: M, W 3:00-4:00 PM or by appointment
Phone: 394-2364;
Course E-mail: StatPhys743@gmail.com
Course website: http://www.phy.sdsmt.edu/~andre/PHYS743

Note: Students with special needs or requiring special accommodations should contact the instructor, Dr. A.G. Petukhov, at 394-2364 and/or the campus ADA coordinator, Julie McCoy, at 394-1924 at the **earliest** opportunity.

Note: Some homework assignments may require use of Wolfram Mathematica: http://www.wolfram.com/mathematica/. SDSM&T has 20 Wolfram network licenses available for student use. Students may also consider purchasing discounted individual student licenses to use Mathematica on their personal computers (optional).

Homework	35 % each	A	> 90 %
Midterm Exam	30 %	B	90% - 75 %
Final Exam	35 %	C	75% - 60%
		D	60%-50%
		F	<50%

Tentative Lecture Topics

Principles of statistical mechanics. Statistical distributions and ensembles. Liouville's theorem. Microcanonical ensemble. Entropy.

Thermodynamics. Temperature. Heat and work. Free energy and thermodynamic potential. Legendre Transformations. Applications

Gibbs Distribution. Canonical ensemble and the Gibbs distribution. The Maxwellian distribution. Free energy in the Gibbs distribution. Grand canonical ensemble. Justification of thermodynamics

Classical ideal gases. The Boltzmann distribution. The equation of state of an ideal gas. Equipartition theorem. Monoatomic and polyatomic gases.

Quantum ideal gases. The Fermi distribution. The Bose distribution. Degenerate Fermi gas. Degenerate Bose gas and Bose condensation. Blackbody radiation. Crystal lattice vibrations and phonons. Debye's interpolation formula.

Fluctuations. The Gaussian and Poisson distributions. Fluctuations of the fundamental thermodynamics quantities. Noise spectral function. Johnson-Nyquist noise. Fluctuation-dissipation theorem.

Strongly interacting systems and phase transitions. Magnetic systems. Mean field approximation. Order parameter and Landau expansion. Ising model.