**PHYS 607**

**Syllabus**

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**Office Hours:** MWF 9:20-10:20

**Office phone:** 1-404-981-7799 (via Google voice)

**Text:** These books are required.


**Grading:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 exams</td>
<td>60%</td>
</tr>
<tr>
<td>Final (comprehensive)</td>
<td>20%</td>
</tr>
<tr>
<td>Homework</td>
<td>20%</td>
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</tbody>
</table>

Evening exams on Feb 23, Mar 22, and Apr 19; 7:00-9:30 pm; MPHY 213

Final exam May 4, Friday 3:00pm – 5:00pm, MPHY 107

**Syllabus:**

<table>
<thead>
<tr>
<th>Wk</th>
<th>Date</th>
<th>Topic</th>
<th>Sections in Text</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan. 16</td>
<td>No Classes</td>
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<tr>
<td></td>
<td>Jan. 20</td>
<td>Temperature. Macroscopic motion.</td>
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<tr>
<td>2</td>
<td>Jan. 23</td>
<td>Thermodynamic potentials: energy, enthalpy, Helmholtz free energy, and Gibbs free energy. Maxwell relations between thermodynamic derivatives and Jacobians.</td>
<td>LL14,15,16</td>
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<tr>
<td></td>
<td>Jan. 25</td>
<td>HW 1 given. Relations between thermodynamic coefficients. Equation of state and specific heats. Thermodynamic inequalities.</td>
<td>LL 12-16</td>
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<td>Jan. 27</td>
<td></td>
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<tr>
<td></td>
<td>Feb. 1</td>
<td>HW 2 given. Number of particles as an external parameter. Chemical potential. Solving problems in thermodynamics.</td>
<td>LL 16,21</td>
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<tr>
<td></td>
<td>Feb. 3</td>
<td>Mixture of gases</td>
<td>LL 93</td>
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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 -
<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>References</th>
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</thead>
<tbody>
<tr>
<td>Feb. 10</td>
<td>Entropy. Level spacing of macroscopic system. The law of increase of entropy.</td>
<td>LL 7-8</td>
</tr>
<tr>
<td>Feb. 13</td>
<td>Microcanonical distribution. Canonical (Gibbs) distribution. T-P distribution. Curie's law for independent 1/2 spins in magnetic field.</td>
<td>LL 28, 36, K.1 ex 4,10</td>
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<tr>
<td>Feb. 17</td>
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<tr>
<td>Feb. 20</td>
<td>Thermodynamics and Gibbs distribution in the presence of external fields.</td>
<td>LL 25, K.2 pr 3,4</td>
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<tr>
<td>Feb. 22</td>
<td>HW 5 given. Thermodynamics and Gibbs distribution of rotating bodies. Thermodynamic perturbation theory (classical).</td>
<td>LL 26, 34, 32</td>
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<td>Feb. 24</td>
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<td>Feb. 27</td>
<td>Thermodynamic perturbation theory (quantum). Boltzmann distribution.</td>
<td>LL 32, 37, 38</td>
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<tr>
<td>Mar. 2</td>
<td>The law of equipartition. Monoatomic gases. Rotation of molecules. Polyatomic gases.</td>
<td>LL 44, 45, 46, 47-51, K.3 ex 2</td>
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<td>Mar. 5</td>
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<td>Mar. 9</td>
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<td>Mar. 21</td>
<td>HW 8 given. Van der Waals equation. Ideal quantum gases. Fermi and Bose statistics. Ideal quantum gases not in equilibrium.</td>
<td>LL 76, 53-55</td>
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<td>Mar. 23</td>
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<td>Mar. 26</td>
<td>Fermi and Bose gases of elementary particles. A degenerate electron gas.</td>
<td>LL 56-57</td>
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<td>Mar. 30</td>
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<td>LL 59</td>
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<td>Apr. 2</td>
<td>Magnetism of an electron gas. Pauli paramagnetism. Landau diamagnetism. De Haas-van Alphen effect.</td>
<td>LL 61-62, K.4 ex 3-4</td>
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<td>Apr. 6</td>
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<td>Date</td>
<td>Assignment/Notes</td>
<td>Reference</td>
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<td>Apr.13</td>
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<td>Apr.18</td>
<td>HW 12 given. Phase transitions of the second type. Spontaneous symmetry breaking. Order parameter. The discontinuity of specific heat. Effect of an external field on a phase transition.</td>
<td>LL 142-144</td>
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<tr>
<td>Apr.20</td>
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<tr>
<td>Apr.23</td>
<td>Effect of an external field on a phase transition. Fluctuations of the order parameter. Applicability of Landau theory of phase transitions. Levanyuk-Ginzburg criterion.</td>
<td>LL 144-149</td>
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<td>Apr.27</td>
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<td>Apr.30</td>
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<td>May 1</td>
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