School of Physics and Astronomy

Syllabus for PHYS 20352: Thermal and Statistical Physics 10/11

PHYS 20352 Physics core unit

Dr. Y. Xian Credit rating: 10

THERMAL AND STATISTICAL PHYSICS

Prerequisites: PHYS 10352 [./../../10_syllabuses/physics_level1/phys_10352.html] , PHYS 20101 [./../../10_syllabuses/physics_level2/phys_20101.html]

Follow up units: Many third and fourth year units, especially PHYS 30151 [./../../10_syllabuses/physics_level3/phys_30151.html]

Classes: 24 lectures in S4

Assessment: Tutorial work and attendance (5%)

1 hour 30 minutes examination in May/June (95%)

Recommended texts:

Mandl, F., *Statistical Physics*,2nd edition (Wiley)

Bowley, R. & Sanchez, M., *Introductory Statistical Mechanics*, 2nd edition (Oxford)

Zemansky, M.W. & Dittman, R.H., *Heat and Thermodynamics*, 7th edition (McGraw-Hill)

Feedback

Feedback is through weekly tutorials and marked tutorial work.

Aims

- To develop the ideas of classical thermodynamics
- To deepen the appreciation of the link between the microscopic properties of individual atoms or other particles and the macroscopic properties of many-body systems formed from them
- To demonstrate the power of statistical methods in physics

Learning outcomes

On completion successful students will be able to:

1. Demonstrate an understanding of the first and second laws of thermodynamics, and of the concept of entropy;
2. Explain and derive the fundamental thermodynamic relation;
3. Use the formalism of thermodynamics, including the thermodynamic potentials and

Maxwell's relations, and apply these tools to simple systems in thermal equilibrium;

4. Explain the basic concepts of statistical mechanics, including the derivation of the general formula for entropy in terms of the ensemble probability distribution function;
5. Explain the statistical origin of the second law of thermodynamics; and
6. Construct a partition function for a system in thermal equilibrium and use it to obtain thermodynamic quantities of interest.

SYLLABUS

1. Classical thermodynamics: the first law (approx. 4 lectures)

2. Classical thermodynamics: the second law

*From heat engines to entropy (approx. 4 lectures)

*Thermodynamic potentials and Maxwell's relations (approx. 4 lectures)

3. The statistical theory of thermodynamics

*Microstates and macrostates; ensembles (approx. 1 lecture)

*The statistical interpretation of entropy and temperature (approx. 1 lecture)

*The spin-½ paramagnet (approx. 1 lecture)

4. Statistical physics of non-isolated systems

*The derivation of the Boltzmann distribution (approx. 1 lecture)

*The independent-particle approximation (approx. 1 lecture)

*The partition partition and its connection with thermodynamics (approx.. 1 lecture)

*Examples of partition function calculation (approx. 2 lectures)

*The equipartition theorem (approx. 1 lecture)

*The ideal classical gas (approx. 2 lectures)

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