PH3012 - Thermal and Statistical Physics

Credits: 15.0  Semester: 2
Number of Lectures: 27  Lecturer: Prof Steve Lee and Dr Irina Leonhardt
Academic Year: 2016-17

Overview
Thermodynamics and Statistical Physics provide complementary approaches to understanding many-body states of matter. This course introduces the fundamental ideas and methods of both approaches and applies these to systems in thermal equilibrium, covering systems of both quantum mechanical and classical particles. Physical examples are used throughout to develop the ideas in a concrete way.

Aims & Objectives
To present the fundamental ideas and methods of Thermodynamics and Statistical Physics, and to develop these through simple examples and applications. The presentation includes:

- Laws of thermodynamics
- Thermodynamic potentials and Maxwell's relations
- Application to simple thermodynamic systems
- Statistical ensemble of distinguishable particles and Boltzmann entropy
- Counting for particles with quantum statistics
- Important examples of statistical physics: paramagnets, heat capacity in crystals, ideal classical and quantum gases, Bose-Einstein condensation, and electrons in metals. White dwarfs and neutron stars.

Learning Outcomes
By the end of the course the students will be expected to:

- State the laws of thermodynamics in their various forms and explain their physical significance.
- Derive and state Maxwell's relations and apply them to problems in thermodynamics.
- State the thermodynamic potentials and recognize the most appropriate potential for application to a particular problem.
- Derive and state the Boltzmann, Fermi-Dirac and Bose-Einstein distributions.
- Know the key links between thermodynamics and statistical physics and apply these to problems.
- Be able to explain the importance and significance of the partition function, and be able to construct partition functions for systems and extract thermodynamic properties from them.

Synopsis


Pre-requisites
PH2011, PH2012, [MT2001 or (MT2501 and MT2503)], (PH3081 or PH3082 or [MT2003 or (MT2506 and MT2507)])

Anti-requisites
None
Assessment
Continuous Assessment = 20%, 2 Hour Examination = 80%

Additional information on continuous assessment etc

Please note that the definitive comments on continuous assessment will be communicated within the module. This section is intended to give an indication of the likely breakdown and timing of the continuous assessment.

This module is part of the core JH programme, and as such there is a summary of deadlines etc on the School’s Students and Staff web pages. Students have compulsory tutorials every two weeks, with hand-in tutorial work counting for 20% of the module mark.

Accreditation Matters
This module contains material that is or may be part of the IOP “Core of Physics”. This includes
Probability distributions
Black body radiation
Kinetic theory of gases and the gas laws to Van der Waals equation
Statistical basis of entropy
Maxwell-Boltzmann distribution
Bose-Einstein and Fermi-Dirac distributions
Density of states and partition function

Recommended Books
Please view University online record:
http://resourcelists.st-andrews.ac.uk/modules/ph3012.html

General Information
Please also read the general information in the School’s honours handbook.