PH4211 Statistical Mechanics

Department:	**PHYSICS**	Academic Session:	201011
Course Title:	Statistical Mechanics	**Course Value:** **Level:**	0.5 cu Masters
Course Code:	PH4211	**Course JACS Code:**	H311/F340
Availability:	Spring Term	**Course Code:**	Optional
Pre-requisites:	PH2610	**Co-requisites:**	
Co-ordinator:	Professor B P Cowan		
Course Staff:	Professor B P Cowan		
Aims:	Consolidation of previous knowledge and understanding of Statistical and Thermal Physics within the context of a more mature framework. Introduction to the ideas and concepts of interacting systems. Introduction to the ideas and concepts of phase transitions including some specific examples. Introduction to the ideas and concepts of irreversibility: non-equilibrium statistical mechanics and irreversible thermodynamics.		
Learning Outcomes:	On completion of this course, students will be able to: - explain the difference between the macroscopic and the microscopic descriptions macroscopic phenomena; - explain the essential concepts in the laws of thermodynamics from both macroscopic and microscopic perspectives; - apply the methods of statistical mechanics to simple non-interacting systems; - demonstrate how weakly-interacting systems may be studied through approximation schemes; - describe the phenomena and classification of phase transitions; explain and demonstrate some of the approximate methods of treating phase transitions, including the van der Waals method, mean-field approaches; - describe and demonstrate how the Landau theory provides a general framework for the understanding of phase transitions; - explain how irreversibility and the transition to equilibrium may be understood in terms of fluctuations; - show how the Langevin equation provides a link between transport coefficients and equilibrium fluctuations.		
Course Content:	Review of equilibrium statistical mechanics. The grand canonical ensemble. Bose and Fermi distribution functions. Classical partition functions. Weakly Interacting Systems: The imperfect gas and the virial expansion, second virial coefficient for various models. The van der Waals gas and mean field theory for magnetic systems. Strongly Interacting Systems: Phenomenology of phase transitions, Scaling ideas, corresponding states. The Ising model. Magnetic case, lattice gas and phase separation. Landau theory. First and second order transitions. Ferroelectrics. Broken symmetry, Goldstone bosons, fluctuations, Ornstein Zernike, soft modes. Dissipative Systems: Fluctuation-dissipation theorem, Brownian motion, Langevin equation, correlation functions.		
Teaching & Learning Methods:	26 lectures + 4 seminars/tutorials. 120 hours spent learning material, answering coursework problems and revision.		
Details of teaching resources on Moodle:	- Course outline - Lecture notes/summaries - Additional notes - Links to material of interest - Problem assignments and solutions (at the appropriate time) - Links to past examination papers and selected solutions		

Key Bibliography:	B. Cowan, *Topics in Statistical Mechanics*, Imperial College Press 2005 (530.13.COW) R. Bowley and M. Sànchez, *Introductory Statistical Mechanics*, 2nd ed. OUP 1999 (530.13.BOW) P Chaikin & T Lubensky, *Principles of Condensed Matter Physics*, CUP 1995 (530.14.CHA)
Formative Assessment & Feedback:	Written and verbal comments on coursework assignments.
Summative Assessment:	**Exam:** (90%) (2½ hour) Three questions to be answered out of five. **Coursework:** (10%) Best six of the eight coursework assignments. **Deadlines:** Coursework assignments to be submitted every two weeks.

The information contained in this course outline is correct at the time of publication, but may be subject to change as part of the Department's policy of continuous improvement and development. Every effort will be made to notify you of any such changes.